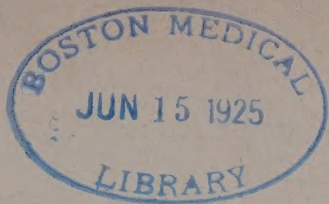


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EDITORIAL.

One cannot run his eye over the record of the social uplift efforts being put forth in these days or merely recount the names of the various societies, from the Better Babies Bureau up, without pausing occasionally to wonder what would happen if there were none of these societies and how long it would be before the entire social fabric would be disrupted by the ravages of disease, both social and physical, and reduced to a condition of economic dependence through the failure of the youth to maintain the highest degree of efficiency as measured by present-day efficiency tests. The last part of the Sermon on the Mount, from the twenty-fifth verse of the sixth chapter of Matthew on, seems like contradictory, not merely antiquated, doctrine in these days.

Now comes the American Posture League preaching the gospel of physical efficiency through attention to posture in standing, sitting, and walking, whether for rest or recreation, or when at work; through attention to the clothing of children and adults, seeing to it that the public is educated to know what is best and where it may be had; through scientific study of the problems of school and factory hygiene to secure the greatest efficiency by instruction in the ways of overcoming the physical hardships incident to the special conditions and environment under which the world's work is being done; by lessening the wear and tear and fatigue of travel, both local and long distance, through the application of sensible suggestions to the seating of travelers using the transportation facilities of the country, and in many other ways contributing to the health and therefore enhancing the potentiality of the race for effective service. The day of "taking no thought for your life, what ye shall eat, or what ye shall drink; nor yet for your

body, what ye shall put on" has gone by, and has given place to an absolutely opposite doctrine, one which concerns itself with every conceivable detail of our personal life.

The following outline of the purposes of the League will be of interest.

Official announcement was made on April 2, of the incorporation at Albany of the American Posture League, a national body formed to improve human health and efficiency, through interesting the public in correct physical posture and the improvement of conditions affecting it.

The new organization is concerned with the sitting and standing position of children in schools and of adults in shops, offices, factories and elsewhere. It hopes to effect a more general use of scientific and healthful principles in seating accommodations for working purposes and for public audience rooms and vehicles.

"A child cannot achieve proper chest development," is its authoritative statement, "while the shape of his school seat and of his coat force him for many hours each day into faulty attitudes. Thousands of children who carry heavy loads of school books are forced into distortions of posture that in all but the most robust must have a serious effect on health and development. Round shoulders are to be expected in a child whose clothing is supported without proper regard for the anatomy and mechanics of the shoulder. The fatigue of the factory operative comes not more from running the factory machinery than from running the bodily machinery—heart, lungs and digestive organs—at a mechanical disadvantage, through ill-adapted chairs, stools and work benches. Measures to relieve tuberculosis, anemia and malnutrition are all placed at a disadvantage by the constant moulding influence exerted on habits of posture by much that is bad in furniture and clothing.

No organized attempt to standardize these various conditions has ever been made before. Individual orthopedic surgeons, and in a few instances special commissions, have attempted improvements, but the skill and judgment of the experts have never been combined in united effort. A great field of hygiene

and preventive medicine is ready for cultivation, and the American Posture League is peculiarly fitted to enter it, since it includes in its membership leading orthopedic surgeons, physical trainers and educators who have specialized on these subjects for years.

The League hopes by systematic education to establish a demand for healthful standards in what may be termed posture engineering. It is definitely organized to do technical work along these lines. For example, it is already assisting with expert advice the engineers of the Brooklyn Rapid Transit Company, the seats of whose new subway cars are being constructed in accordance with the League's specifications. It is in touch with several large organizations of workers engaged in the standing occupations—such as motormen and shopgirls—and purposes issuing official bulletins for their benefit, illustrating the correct standing postures, both for work and rest.

Bulletins taking up the various phases of school and factory hygiene that affect posture, and making constructive suggestions, will also be issued to school superintendents and other officials throughout the country, as well as to heads of private schools and colleges and to efficiency managers. Lantern slides will be prepared and circulated to supplement a country-wide campaign of education by means of bulletins.

The League owes its inception to its President, Miss Jessie H. Bancroft, Assistant Director of Physical Training in the public schools of New York city. On its board of directors are Dr. Frederick R. Green, of Chicago, Secretary of the Council on Health and Public Instruction of the American Medical Association; Dr. Joel E. Goldthwait, of Boston, ex-President of the American Orthopedic Association; Dr. R. Tait McKenzie, the well-known sculptor, who is Director of the Physical Education Department of the University of Pennsylvania; Dr. Henry Ling Taylor, professor of orthopedic surgery in the New York Postgraduate Medical School; Dr. Thomas A. Storey, professor of hygiene and physical instruction in the College of the City of New York; Dr. S. Josephine Baker, Director of the Department of Child Hygiene, New York

City Board of Health; Dr. Eliza M. Mosher, of Brooklyn; Dr. Eleonora Everhard, of Dayton, Ohio; Dr. William H. Burnham, of Worcester, Mass., and Dr. E. G. Brackett, of Boston.

The board of electors, by whom the directors are chosen, is headed by Philander P. Claxton, United States Commissioner of Education, and has among its members William H. Maxwell, Superintendent of Schools, New York City; Professor Irving Fisher, of Yale; Chairman of the Committee of One Hundred to Promote Public Health; Dr. Robert L. Dickinson, of Brooklyn; Dr. Fletcher B. Dresslar, specialist in school hygiene and school sanitation United States Bureau of Education and President-elect of George Peabody College for Teachers, Nashville; Miss Amy Morris Homans, Director of Physical Education and Hygiene, Wellesley College; Dr. William Webber Ford, Johns Hopkins Medical School, of Baltimore; Dr. Melville Dewey, of New York; Dr. J. George Adami, of Montreal; and Dr. Ernest B. Hoag, of Los Angeles. There is also an advisory board of prominent men and women.

To meet the expenses of its initial bulletins, technical photography, etc., the League is dependent upon membership fees and hopes by this means to raise \$5000 at once. Life memberships are \$500 or more; one becomes a patron on payment of \$250, an annual donor for \$100 annually, an annual member for \$50 annually, a contributing member for \$25, an associate member for \$10 and an active member for \$1 annually.

The acting Treasurer is Cornelius S. Loder, 30 Church Street.

MALFORMATIONS, MENDELISM AND MUTATION.

For those interested in skeletal conditions the most valuable general address at the late International Medical Congress in London, was that delivered by Professor Bateson upon Heredity. In that address Bateson afforded a review of recent work upon the inheritance of morbid states, and that review included an enumeration of some widespread skeletal malformations. He there described the essence of the Mendelian principle so

simply that we cannot do better than reproduce his statement in his own words.

"It is, first, that in great measure the properties of organisms are due to the presence of distinct, detachable elements, separately transmitted in heredity; and secondly; that the parent cannot pass on to offspring an element—and consequently the corresponding property—which it does not itself possess. The determination or recognition of these elements by analytical breeding is one of the main objects of present-day genetic research. Each germ cell, ovum or sperm, may contain or be devoid of any of these elements; and since all ordinary animals and plants arise by the union of two germ cells in fertilization, each resulting individual may obviously receive in fertilization similar elements from both parents or from neither. In these cases the offspring is 'pure'-bred for the presence of the character in question, or for its absence. But it may be formed by the union of dissimilar germs, one containing the element, the other devoid of it, and in this case we call the individual cross-bred, or heterozygous in that respect.

"A population thus consists of three classes of individuals, those pure for the presence, having received two doses of an element; those pure for the absence of the element, having received none of it; and the cross-breds, which have received one dose only."

The element when present is dominant, that is to say it shows its effect whether this individual is pure-bred and so possesses a double dose, or cross-bred—simplex—possessing only a single dose. If an organism is pure-bred in any respect, all the germ cells are alike in that respect. If it is cross-bred, its germ cells represent in equal numbers the positive and negative elements which were brought together in (the) fertilization (from which it originated).

Leaving out, in the main, metabolic and nervous states, we find that Bateson sums up heritable malformations as follows:

Conditions Showing Dominant Descent.—Brachydactyly (as in Farrabee's well-known pedigree of five generations of a short-fingered Pennsylvania family), congenital cataract (Nettleship),

claw-shaped extremities,* cartilaginous exostoses, membranous craniocleido-dysostosis, hypoplasia of the teeth.

In all these cases, says Bateson, unaffected members of the family do not transmit: not having in them the element which causes the condition they cannot pass it on, and as the individuals having the character are almost always cross-bred and of simplex type, *i.e.*, only one of their parents, not both, have possessed the character and passed it to them, so where a normal individual marries into such stock almost always there are approximately equal numbers of affected and unaffected offspring.

Conditions Showing Recessive Descent.—Of these there is less abundant evidence. In a cross-bred individual the recessive quality does not show itself; but if two cross-bred and therefore apparently normal individuals unite, one-quarter of the offspring may be pure, and therefore recognizable, recessives. Albinism and myoclonus are conditions of this order, but to our knowledge no skeletal defects belong to this category. But as Davenport has shown, feeble-mindedness is recessive, from which it follows that an obviously feeble-minded individual must be a pure recessive, and if he mates with another obviously feeble-minded individual, all the progeny will be feeble-minded, if with a "pure" normal individual none will be feeble-minded, if with a cross-bred normal, about half the progeny is likely to be feeble-minded.

Sex-limited Descent.—Included under this head are the conditions of peroneal atrophy (Herringham) color-blindness, and hemophilia together with some cases of pseudohypertrophic muscular paralysis. In all these cases the affected male mating with a normal woman has apparently normal offspring; apparently normal, but the daughters transmit the affection to half of their sons. Since this has little bearing upon skeletal conditions we will not burden the reader with the *modus operandi* of this mode of inheritance.

There was brought to my notice a few weeks ago a recent Paris thesis for the degree of M. D. on the out of the way

subject of the inheritance among the Spanish Hapsburgs, of thanatomania,* or morbid enjoyment of the trappings and panoply of death. The author traced a succession of manifestations of this strange weakness through long generations, showing how it began with vanna la Folle who travelled around with the coffin of her late spouse Phillip I. as her constant companion, and reached its acme with Phillip II. who ended a week of masses for his father and mother by having a catafalque erected with a coffin in due place, in which he placed himself and had the inexpressible pleasure of listening to the mass for the dead chanted for himself, as if he himself had descended into limbo. And the writer parenthetically, while discussing the familial failings of the Spanish Hapsburgs, afforded a full study of the well-known "Hapsburg lip" or underhung jaw. This, which is recognizable in the present King of Spain, is traceable back as far as Duke Ernest of Austria who died in 1424, and the writer brings forward evidence to show that the inheritance was reinforced by the marriage of Maximilian I. (1459-1519) into the Burgundian family. It appears that Queen Eleonore, wife of Francis I. of France and sister of Charles V., finding herself in Dijon, showed her thanatomania by visiting the tombs of her ancestors the Dukes of Burgundy. At her request, the coffins of those ancestors were opened for her inspection, and as many of the corpses were in excellent preservation she made the discovery that they also had underhung jaws.†

It is extraordinary how, despite amphimixis and the mingling of new blood with the stock in successive generations, certain family traits remain thus dominant through centuries. Nor is this an isolated instance. Thanks to the interest taken in family histories among the good families of the United States, I have been able to trace the outcropping of polydactylism in one family back, if not to the Mayflower, to an ancestor presenting the condition who, migrating from England, settled at Woburn, Mass., in 1620. My friend, Dr. E. Brockbank of

*Mersey, *L'amour de la Mort*. Thèse de Paris, 1912.

†Vide Bouchot, *preface to Galippe's "L'hérédité des stigmates de dégénérescence et les familles souveraines,"* Paris, 1905.

Manchester, England, was so good as to institute enquiries there with the discovery of a family of the same name exhibiting to-day the same malformation in certain of its members, and the information was volunteered that some of this family migrated to America in or about the year 1620. It is clear therefore that the liability to present this deformity must have been present in the parent from whom the present American and English stocks trace their descent: in other words it must date back to the end of the sixteenth century at the latest.

My friend and colleague, Dr. A. C. Geddes, Professor of Anatomy at McGill, has given me a series of X-ray photographs, taken from a Shetland family in which the condition of "claw hand" and "claw foot" can be traced back to the first half of the seventeenth century. It is a delightful old world tradition. In the days of Charles I., when Archbishop Laud was doing his best to force Episcopalianism upon the Scottish people—to be eventually repulsed by Jennie Geddes with her stool in St. Giles's, Edinburgh—in the remoter Galloway region the emissaries of the Archbishop are said to have carried matters with a high hand, even to the extent of staking recalcitrants upon the sands of the Solway. The crime, it was held was not—or was more than—sufficiently serious that they should be condemned and executed by man: it was left to the higher powers to determine their fate. If they were innocent surely an all-wise Diety would not allow the inrushing tide to rise and drown them; if they were guilty, well—let them drown and good riddance. Church and State worked hand in hand in those days, and recalcitrancy in religion spelt disloyalty. And so it happened that a certain rugged royalist, Peter Bell, saw Margaret his betrothed, duly staked out, if he did not help in the process. But as the tide rose and seemed likely to overwhelm her, the sight was too much for his affections. He must give her the chance to save herself. Wherefore he rowed out to her. Said he, "Wull ye no say 'God save King Charles'?" And she: "No, I'll no say 'God save King Charles;' I'll say 'God save King Charles an he will.'" Taking all things into consideration it was a strictly logical and for the period reasonable answer.

It was but doing as she was being done by. But Peter Bell the first, thinking possibly of a future married state, construed it otherwise. "Na, Na," said he, "I canna save ye for that. Ye maun clap down amang the pairtins (crabs) and be drowned." Whereat Margaret: "The curse of the pairtins be on thee, Peter Bell, and on a' thy bairns for a' generations." The rising waters stopped further parley.

Now in due time Peter Bell took unto himself a wife and found himself waiting one night in the "but" anxiously expectant. Presently the "howdie" called out from within "Bell! Bell! thy bairn's born: he's clept, cleppit like a pairtin!" And ever since claw-handed and claw-footed individuals have occurred among his descendants for now five generations. Members of the family went to Shetland, and there many of the descendants exhibit the defect even to the possession of four "clawed" extremities. Rumour, indeed, has it that as the defect may lie latent, and the apparently sound male members of the family have a distinct predilection for military service, the defect has shown itself in the wake of Scottish regiments in Europe, in the Peninsula and low countries, and is beginning to show itself in India and various other regions of the world.

To the student of genetics these cases present problems of great interest. Its very persistence generation after generation in the direct line shows clearly that the property is dominant: in fact the Hapsburg lip is ultra-dominant. Even admitting that there have been numerous intermarriages of relations among the Hapsburgs, it shows itself too persistently to harmonize with the theory of probabilities as this bears upon the transmission of a simple dominant character. When the chances are even that a given feature either shows itself or is absent in any individual member of a family, we would be prepared to find the feature appearing in three or four successive generations, but not prepared to find it still there after fifteen or more generations. This is perhaps scarcely the place to enter into a full discussion of the conveyance in descent of unit characters. If any of our readers desire to gain a working knowledge of this subject quite the best and clearest exposition of these laws of descent is

afforded by Professor H. E. Walter in his little work in "Genetics."* It might be suggested that the underhung jaw is a sex-limited dominant condition, in other words that the sperm cells which convey the attribute of maleness, convey also the attribute of "prognathism." Unfortunately, however, this does not harmonize with the known examples of sex-limited inheritance in man—with the genealogies of the color-blind and of families of bleeders. In them as already stated, the descent is of a different order, namely, such is the constitution of sperm cell and ovum respectively that the offspring of a color-blind father and a normal mother are *none* of them color blind, but the property of color-blindness is conveyed to the daughters, and the property reappears in one-half the number of their sons.

With polydactylism other complications show themselves. It is against our current conceptions that a dominant property when conveyed to the offspring should lie latent: if the property be present in the germ cells it should show itself in the individual; herein differing from a recessive quality. And yet in the pedigree of the family studied by me, the great grandfather was free from the defect although other members of the generation were affected; the grandfather was free, as was the father, although an uncle and aunt were polydactylous. Notwithstanding this absence of the condition for three generations in direct line, my student who afforded this pedigree had a complete functional extra digit on each hand and foot. This same tendency to latency of the condition has been observed in split or claw-handed families.

Davenport has attempted to explain such cases by variation in "potency" of particular determinants in different members of the same stock; the determinant may be there but "unable to complete its entire ontogeny." This, however, is only another way of saying that dominant characters may not be dominant in a particular generation.

Bateson, who frankly admits the difficulties, attributes the lack of conformity to the Mendelian rule in part to imperfection in records, in part to real peculiarities in the process of segrega-

*The Macmillan Co., 1913.

tion of unit characters in the maturing germ cells. He points out that in hybridizing certain plants like wheat and peas, the expected numbers appear with great constancy, but in others, like stocks and primulas, long "runs" are so common that smooth results are only obtained by the summation of long series of observations.* Elsewhere† he suggests that the irregular results in polydactylism are to be ascribed to the dominant factor being inhibited or suppressed in consequence of this presence of other factors and with regard to split extremities admits that the degree of malformation is extremely irregular, and the number of affected persons higher than the expectation; concluding that it is improbable that any simple Mendelian scheme will express all these descents.

On the whole we are inclined to believe that in this order of deformities we have to take into account the distinction which de Vries has drawn between the crossing or hybridization of varieties and of species respectively. Varieties, he holds, consist in the apparent loss of some qualities active in the species: the presumably lost characters have not absolutely, or at least permanently disappeared. They show their presence by some slight indication of the quality they represent, or by occasional reversion. Recessive qualities are not wanting, only latent. Thus if two varieties of a species are paired, they constitute *balanced crosses*. Every quality in the one germ finds its mate in the other, whether active or latent: all the unit characters and their "allelomorphs" combine in pairs, exactly as is known to happen in ordinary fertilization.

Such it may be said, constitutes ordinary Mendelian hybridization, and for such Mendel's law is found operative.

But clearly deformities of the order here being discussed have originated as mutations; they are new properties which have appeared suddenly in the stock like the observed sudden appearance of short leggedness, in what starting from a single Massachusetts sheep in 1791 has been developed into the Ancon breed of sheep. Now as Bateson has emphasized, it is this

* Addresses on Heredity, XVII International Congress, of Medicine London, 1931.

† Mendel's Principles of Heredity, Cambridge, 1909, p. 228.

discontinuity, or sudden appearance of a new property, that constitutes the development of a species—as distinct from a variety. If therefore an individual showing a mutation is paired with a normal individual, there results an *unbalanced cross*: there is something communicated by the one parent, which has no counterpart in the germinal matter communicated by the other parent.

As de Vries has demonstrated, it is a mistake to imagine that the hybrids of distinct species are necessarily infertile. The last number of the *Journal of Heredity* for example, contains two interesting articles upon the formation of herds of “cattalos”—crosses between ordinary cattle and the American bison or buffalo. The interesting part of de Vries’ observations is that such hybrids *do not conform to Mendel’s law*: they exhibit the distinguishing marks of both parents. As far as the characters do not interfere with each other they may be fully developed side by side. Accompanying this all the individuals in each generation tend to be alike. There is not the sorting-out process seen in the second filial generation in true Mendelian inheritance. This order of events fits in more closely with the inheritance of the deformities in question than does the Mendelian order.

How do such mutations arise? That is a difficult question to answer. Nevertheless we appear to be approaching a solution of the question.

For us as medical men seeking to understand the cause of marked departures from the normal, the weak point of Mendelism is that it only covers a limited part of the territory. It does not pretend to—it can never—throw light upon progressive or regressive evolution. It can but explain the permutations and combinations of unit characters already possessed by the members of a species. It can go no further: it cannot explain the appearance of new unit characters, the development of new species.

This, we think, is not generally comprehended. We have to pass beyond Mendelism, for example, for an explanation of these heredity deformities, whether they be in the direction of excess or of defect.

It is along the line of chemical or physical alteration of environment that we most expect to gain the solution of these problems. Ultimately, as I have pointed out, on more than one occasion during the last ten years, the structure of matter depends upon its constitution, and it is by seeking to modify the chemical and physical environments of the germ cells that we are most likely in the first place to obtain alterations in the constitution of those germ cells, and secondarily alterations in the fully formed individuals developing therefrom. During the last few years work based upon this line of thought has been undertaken with certain striking results. I will not discuss the simplest case of all, namely, the development of mutants among bacteria by chemical alteration in their environment, but would call attention by Professor Tower's remarkable observations upon the potato beetle, in which by subjecting individual beetles as they approached sexual maturity to altered temperature conditions, he produced offspring differing markedly from their parents, and the rest of the species, in the markings upon their wing cases, and found that these crossed with each other, under normal temperature conditions, did not revert to the normal marking, but bred true to the induced alteration. Here the last few months have seen a notable advance in the observations of Stockard of New York upon alcoholized guinea-pigs. His observations are to be found in detail in the "American Naturalist," vol. xlvii, November, 1913.

It may be noted in brief that Stockard found that by subjecting guinea-pigs to the fumes of alcohol he could cause a daily mild stage of intoxication over several months without obvious disturbance of the general health, the animals, indeed, fattened under the process. But this told upon their descendants. Even where the bucks alone were so treated—the crucial test—there was an increased number of sterile matings, and of permature births; the litters were smaller, there was a pronounced increase in the number of the young dying within a few days after birth, while those that survived were stunted. And here is the interesting point: if he took these offspring of alcoholized parents, which themselves had never even smelt alcohol,

and mated them, their progeny was defective, often even more defective than their parents and presenting definite deformities, such as lack of development of the eyes with associated cranial malformations, and imperfect development of the limbs. Stockard, thus, is the first who has succeeded in so treating warm-blooded animals, experimentally, as to demonstrate that *hereditary* degenerations and defects may be induced by the action of different chemical agents upon the germ cells. I have for many years taught that this must be the case, that a large proportion of the deformities we encounter is due to intoxication of the germ cells of one or other parent, whether by the toxins of infectious disease, or by one or other drug; indeed, years ago, feeding guinea-pigs with minute doses of soluble lead salts, I attempted to carry out, without success, what now with alcohol Stockard has so brilliantly and so ingeniously accomplished.

The appearance then of deformities in any stock is not a chance affair; nor have we to content ourselves with the thought that the defective trait of necessity dates back to tendencies that have been latent or obvious in the stock for long generations. It may date back only to influences telling upon the germ plasm of parent or grand-parent. The germ cells can be acted upon and so we may influence the derivative germ cells of future generations, and what is more the changes and their effects may be intensified by inbreeding, or the mating of those presenting like defects.

To the readers of this Journal it would be absurd to propound that all malformations are inherited. It goes without saying that there is a distinct group of disturbances of congenital origin, due to the mechanical effects of pressure, lack of adequate amniotic fluid, disease, etc., *in utero*. But even here Bateson has an interesting observation. While conditions of hallux valgus dislocation of the hip or radius and other deformities attributable to intrauterine disturbance most frequently affect but a single member of a family, it will be familiar to the readers of this Journal, that occasionally we encounter several members of a family possessing defects of this nature, and what is more, in

certain families the conditions may be transmitted from parent to offspring. Bateson compares these phenomena with those often noted in incubator eggs—"When the incubators are mismanaged, many of the chickens are born with deformed feet. Such abnormality, however, is found with especial frequency in particular strains of birds (for), eggs from other strains exposed to the same condition may give perfectly normal results."

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THE TREATMENT OF TUBERCULAR COXITIS.

BY DR. R. WERNDORFF,

Assistant in the University Ambulatorium for Orthopedic Surgery, Vienna, Direction
Professor Adolf Lorenz.

The articles by Packard, Taylor and Bradford, and the discussion of Taylor's article by Lovett, Ely, Wilson Gibney, Albee and Mackenzie, published in the *American Journal of Orthopedic Surgery* for February, 1913, prove that the treatment of tubercular hip-joint disease beyond the Atlantic is still in an unsettled state.

The Lorenz clinic is very much interested in this question: Primarily, because she has during the past decades observed a vast amount of material relative hereto, and secondly, because Lorenz it was, who has grounded and worked out the weight-bearing therapy of tubercular coxitis in place of the conventional traction therapy.

This latter circumstance, however, has not been given due credit by our American friends in the above-mentioned articles and discussion. With the exception of the acknowledging words of Gibney, I fail to note that literary historical justice, which is fundamental to the promotion of scientific discussion.*

It is for this reason that I wish to particularly emphasize the credit due Prof. Lorenz for his work in this subject.

Traction or weight bearing, that is the question!

For us, however, it is no more a question, and this for the

* Polemical discussions as to priority have but little part in the discussion of papers on this side the Atlantic. I am sure we should all be willing to concede to Dr. Lorenz and his confrères the credit of giving the proper emphasis to fixation methods in the treatment of hip disease. That we don't debate these points indicates that we attach less importance to them than do our German colleagues.
[Eds.]

This adduction occurs in every phase of walking in which the diseased limb is used. It can easily be shown that complete paralysis of the pelvitrochanteric muscles is associated *absolute* insufficiency of the hip-joint. The patient cannot, without support or apparatus, walk with nor step on the diseased limb.



FIG. 1.—Functional test of the normal hip-joint. Pelvic axis—femur angle abc over 90° .

Paralysis or paresis of the pelvitrochanteric muscles is therefore the most striking example of insufficiency of the hip-joint.

A tubercular hip-joint becomes insufficient for several reasons. First and most important, an *absolute insufficiency* of the pelvitrochanteric muscles is present, because of the very

high grade of demonstrable atrophy of these muscles. This is for the most part an arthrogenous, degenerative muscle atrophy, arising from a local damaging influence of the tubercular virus. To a lesser degree the atrophy is one of inactivity. The condi-



FIG. 2.—Insufficiency of the right hip-joint. Elevation of the greater trochanter. Pelvic axis—femur angle abc under 90° .

tion of the pelvitrochanteric muscles in coxitis may therefore be compared to a hip-joint with paresis of the pelvitrochanteric muscles.

Aside from this *absolute* insufficiency, there is also a *relative* insufficiency of the pelvitrochanteric muscles in the coxitic

patient. The greater trochanter rises toward the crista ilei during intraarticular destruction, clinically therefore upward over the Roser-Nelaton line and with this narrowing of their points of origin and insertion, the pelvitrochanteric muscles become too long and are unable to maintain equilibrium against the weight of the trunk. The pelvis therefore falls to the unsupported side, and an adduction is produced on the diseased side at every step by the whole body-weight.

The correctness of this explanation is easily seen in those cases in which there exists a plainly demonstrable high position of the greater trochanter, with a very evident relative lengthening of the pelvitrochanteric muscles.

I have, however, been able to show that very small intra-articular destructions offer mechanical conditions similar to those mentioned above, and that even the very smallest intra-articular displacements are therefore always accompanied by adduction. Hence the proposition that the position of adduction is the clinical expression of an intraarticular destruction. I have drawn attention to the fact that beginning destruction of the cartilage of the head or of the acetabulum, which can only be demonstrated in the X-ray picture and which clinically does not lead to a rise of the greater trochanter (Fig. 3) must clinically show an adducted position of the joint.

In a series of X-ray pictures obtained from the same joint, the following was established.

The joint stood in abduction flexion and outward rotation, the X-ray picture showed a normal joint aperture, and except for regionary atrophy of joint components, no changes, therefore no intraarticular destruction. After six weeks, during a reexamination, a beginning adduction position of the joint was observed. The spina anterior on the diseased side stood $1\frac{1}{2}$ cm. higher, the trochanter not above Roser-Nelaton's line, the X-ray picture, however, showed cartilage consumption, with intraacetabular displacement (Fig. 3).

There is no doubt, therefore, that in every hip-joint damaged by tuberculosis, adduction is produced at every step by the whole body-weight. The looser the connection between pelvis

and proximal end of femur—in other words, the more movable the joint—the greater is the tendency to adduction. One speaks of procuring mobility and imagines thereby to be able to so obtain a condition of *restitutio ad integrum*. Granted, providing it were possible to so cure the tubercular process, that the joint would retain its normal anatomical form. Under hundreds, perhaps a few thousand coxitides, I have seen the one or other case heal without joint changes and with normal func-

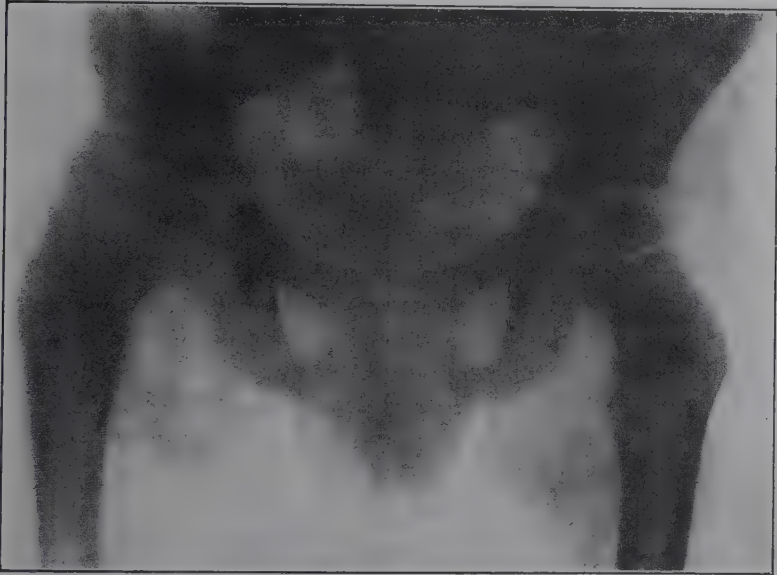


FIG. 3.—Left hip-joint shows intraacetabular displacement of the head. Disappearance of joint aperture.

tion. And against these few cases of healing with *restitutio ad integrum*, can always be raised the objection whether tuberculosis was actually the disease in question and not perhaps some other form of coxarthrititis. In this connection it is well to consider the condition of such a joint, healed with mobility. The capsule is destroyed, the one capsular ligament is shortened and the other lengthened, the acetabulum widened and eroded by bony ridges; the head, if at all present, is deformed, displaced in the acetabulum, and often dislocated. The muscles dis-

placed around the joint, some lengthened and others again shortened and contracted. What hope is there for good function under these conditions? The continual movements in such a joint must cause the greatest suffering to the patient, the joint must, as its position to the direction of weight is abnormal, become sensitive. The joint must, earlier or later, become useless and functionally unfit. It must not be objected that not all coxitis heal with those changes which I have pointed in such somber hues. Even the slightest changes in the cartilage of the head and acetabulum cause those incongruencies which, according to Preiser, lead to a deforming arthritis. And tubercular coxitis, though it may heal with only minimal changes, is almost always mechanically predisposed to an adduction contracture.

In this way we came to the conclusion that the end-result of coxitis therapy should be an ankylosed and not a movable joint. This thesis, when first advanced, provoked general doubt and opposition, but as time went on a small number of advocates came to its support, and we have not given up the hope that we will be able to win others to our conviction.

Remarkable indeed it is that the correct way was suggested to us by the observance of just those coxitis patients who had never been treated and who years after recovery from their hip disease came to us for correction of their deformity. In our remote high and lonely Alpine regions, where for miles no physician's help is to be found, there we observed too often that the coxitic child ran about without any treatment whatever. When the time of military service or of marriage comes, then these patients cannot forego medical help. Their joints are no more painful, but they ask for correction of their deformity. Consider how much better is the condition of these untreated patients, notwithstanding their contractures, than the condition of those carefully treated, in whom extension was so faithfully employed to preserve motion in the joint! Our mountain children run and jump on their healed limb, they climb their high mountains without fatigue. Their limb is strong and only little atrophic, and ankylosed in the hip-joint, not sensitive,

and functionally fit. The position of the leg is, no doubt, mostly very bad and severe flexion and adduction contracture are the rule.

Contrasted with this, the joint, treated by protection from weight-bearing and with extension, is for years sensitive and is even for years, after complete healing, functionally unfit, very easily tired, very atrophic, but, as we confess, in a relatively better position. Flexion is seldom found fully developed and adduction is limited to a lesser degree as long as the extending and weight abolishing apparatus is worn. But when the patient discards these, and sooner or later this always occurs, the adduction rapidly increases, and the long train of suffering with the pressure pains, fatigue and ugly deformity begin anew.

No, we do not want a movable joint! We attempt to secure ankylosis and in the very start of the care of the case we plan so, that relief of pain and the best possible condition for improvement in the local disease process go hand in hand with the obtainment of an ankylotic hip-joint.

From this it is very plain that we take a decided stand against continuous extension. Extension distracts the joint surfaces from each other, thereby offering the best condition for prevention of ankylosis. The pain-relieving components of extension we reach in a more comfortable manner, through simple fixation in a cast. There remains, therefore, now only to consider our position on the influence, exerted by extension, in removing or preventing threatening contractures. Lorenz has advanced the principle that, taken all in all, the contracted position of the coxitic joint should not, during the acute or subacute stages of the disease, claim our attention because, as mentioned above, a local bone or joint tuberculosis is harmfully influenced by every accidental or operative trauma. Every correction of the deformity therefore must be avoided which will in any way traumatize the joint in the least, until complete healing of the pathological process has taken place.

A forcible correction is therefore excluded at the start, and a gradual correction, which is perhaps possible during the course of many months by extension in bed, we discard, because the

prolonged bed rest and disuse of the limb lead to severe disturbances of the bones and muscles, and thereby to uselessness. We prefer a functionally fit strong limb in less good position to one useless, atrophic and sensitive in good position.

We do not wish it to be understood, however, that we under no condition correct the deformity during the acute or subacute stages of the disease. In very early beginning cases which, after careful observation, have shown no spastic contracture of the hip-joint within fourteen days, we do not hesitate to apply the cast in narcosis, if a contracture is then present. I purposely say, to apply the cast in narcosis! because in such a case there can be no thought of correcting a contracture, the muscles relax in narcosis and the correction occurs spontaneously. A second indication for applying the dressing in narcosis we find in those subacute cases with such high-grade flexions or adduction contracture that applying the dressing in the pathognomonic position would preclude the patients walking. This refers mostly to cases which have had for some time a deformity, but in which the deformity has rapidly increased in a few weeks. In these cases by applying the dressings in narcosis we can get these patients on their feet. The purely muscular contractures, namely those which arose in the last weeks, correct themselves spontaneously and the dressings can be applied in a less pronounced deformed position without the use of any force.

We will allow that in these two indications, instead of narcosis a preparatory extension treatment of from eight to ten days might be chosen after which the dressing could be applied.

We discountenance, however, for reasons given above, any attempt to correct by extension contractures existing over a period of more weeks or months. In such cases it is not sufficient to remove the spastic condition of the muscles, but one would have to overcome the long standing, nutritive shrivelling of the soft parts, and this is only possible by prolonged bed extension or the wearing of a correcting suspension apparatus over a period of many months.

The *indicatio morbi*, as well as *indicatio orthopedica* would, with the exception of the two previously mentioned indications,

allow dispensing with extension and permit the choice of a simple dressing for the relief of pain. The only function demanded of this dressing is solely that of fixation. This demand has also its reason. It is based on the knowledge that there are two kinds of joint pain (Lorenz)—(1) Pain during movement of the joint surfaces against each other, and (2) pain during weighting the joint. The pains of the first variety have their cause in changes of the soft parts of the joint, with normal relation of the joint bodies to each other, while the weight-bearing pains have their origin in the incongruence of the joint bodies or in the severe destruction of the joint. Movement pains are caused by folding up of, and pressure on, the infiltrated and swollen synovial membrane during the slightest motion in the joint. The traumatization of the nerves lying in the inflamed synovialis calls forth a reflex spasm of all surrounding muscles. The joint, so fixed by muscular spasm, is no longer sensitive, because by the muscular fixation the cause of the pain is removed; *i.e.*, the unavoidable pulling and traumatization of the synovial membrane during movement of the joint surfaces upon each other.

As in this stage of the disease the bone is still intact, fixation causes the joint to be insensitive and weight-bearing painless. In case of pain due to motion, fixation makes weight-bearing painless. It is obvious, therefore, that all forms of tubercular disease of the hip-joint, in which the joint bodies themselves are not affected, are to be treated by fixative dressings with weight-bearing. This dressing shown in Fig. 4, the Lorenz spica, is as a rule changed at the end of the third month; in cases where, on account of the great distance of the patient's home, this is impossible, a dressing of this kind can be left on a year or even longer. This heavily padded dressing is laid on over a tricot and a strip pulled through for the purpose of cleaning the skin. We lay stress on cutting the plaster dressings at the ends and smoothing these cut surfaces, so as not to allow the dressing to become uncomfortable. In this short spica the patient, as a rule, passes most of his time on his feet and without pain. Often enough our coxitis children are seen playing

about and jumping with their short dressings. As in these beginning cases the hip-joint is usually fixed in spastic abduc-



FIG. 4.—Short spine of the hip.

tion, the lengthening of the leg, due to the abduction position, must be equalized by heightening the sole under the well foot.



FIG. 5.—Leg apparatus. By removing screw at *a*, it is made movable in the knee-joint.

With increasing bone destruction, sensitiveness of the joint arises, which is not relieved by the short spica dressing. In this case the bandage is augmented by a small mechanical splint,



FIG. 6.—Combined dressing I.

Fig. 5, which is made to include the leg and the foot. It is fastened to the hip-cast by starch bandages, and has an arrangement which fixes the knee-joint. In case of necessity the knee-

joint can be made movable by removal of a screw at *a*, Fig. 5. With this combination splint, Fig. 6, it is possible to remove



FIG. 7.—Combined dressing II; perineal strap at *a*.

sensitiveness even in cases of greater destruction. If the patient cannot afford the small sum of seven dollars for this

leg apparatus, then we lengthen the plaster dressing to the malleoli and add a sandal in a similar manner as in the combined dressing, Fig. 7. The combined dressings, Figs. 6 and 7, were developed from the Lorenz original "Geh-Bügel," Fig. 8, and differ only from this by better appearance and the movement in the ankle-joint. The limb in these dressings is as little suspended as in the Lorenz "Geh-Bügel," but the hip-joint is this way more protected against movement than it would be in the



[FIG. 8.—The old Lorenz "Geh-Bügel."

shorter spica. Furthermore, the shock of weight-bearing to the leg is lessened in that the patient rests the leg on the floor by aid of the sandal. The exact fixation of the hip-joint is attained by the perineal strap as pictured in Fig. 7, *a*.

There is nevertheless a phase in this disease in which by the above-mentioned means we are unable to relieve the pains; that is, the stage of intraarticular abscess. As is well known, a beginning abscess of the hip-joint is difficult to demonstrate, as the joint lies so deeply covered by muscles and the capacity of the joint is so small that the symptom of fluctuation is of little

value. When fluctuation is demonstrable the abscess has already perforated the capsule and become extraarticular. I have also shown that we are sometimes able to diagnose early an intraarticular abscess objectively: normally the posterior capsule lies so on the posterior surface of the neck of the femur that there remains a triangular area outside of the joint capsule, Fig. 9. The examiner here palpates normally a deepening running over into the fossa retrotrochanterica. In beginning

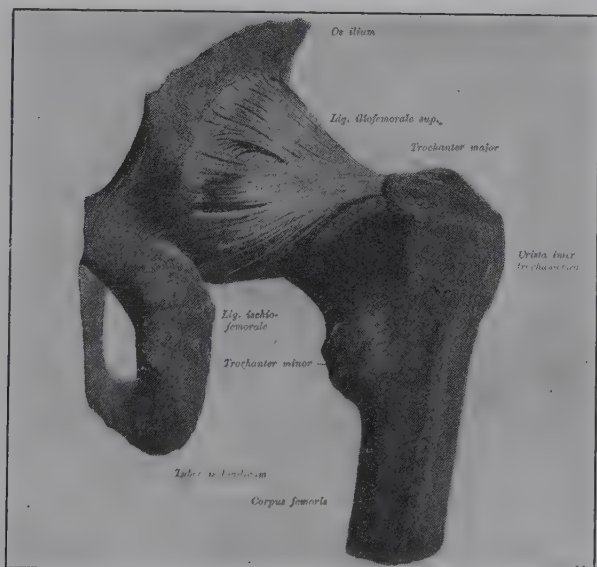


FIG. 9.—(From Ficks, *Anatomie der Muskel u. Gelenke*.) View of hip-joint from back side. Part of femoral neck lies extracapsular.

abscess of the joint, the capsule bulges here and often fluctuation can be obtained. This symptom is, however, not always demonstrable and it is of double interest to note that failures in our otherwise so successful fixation treatment have led us to assume the presence of an intraarticular abscess. A child, which previously was completely free of pain in its dressing, begins suddenly to cry at night—in the beginning once or twice, later oftener. The pains then soon begin during the day and all our efforts with new dressings, combination dressings, and

even fixation inclusive of the healthy hip, remain ineffective: naturally, because the pain is caused by increasing intra-articular tension. The development of the abscess continues weeks and often months, the child continually racked by pain, which may suddenly disappear over night, in the moment the abscess bursts through the capsule. Luckily we possess in puncture of the joint, in a correctly diagnosed case, a means of shortening and lessening the pain of the patient and by relieving the intraarticular tension, we can immediately by our fixation dressings get the patient on his feet again. In this way it is possible for us in most cases to keep the patient up and about during nearly his whole illness. We do not wish to press the bones against each other by our treatment, as was erroneously supposed by some American authors; we only wish to make the limb relatively painless by fixation and avoid specifically distraction of the joint surfaces. It is doubtless true that, according to Volkmann, traces of pressure atrophy are recognizable in congruous joint surfaces. But also it is as true that the healthy bone surrounding the diseased portions reacts to weight-bearing with thickening of the spongiosa and that the static use of the diseased limb furnishes the most favorable conditions for firm union between the joint surfaces. This latter we strive for above all else. We would not even see a disadvantage to the patient if it were proven that the actual shortening of the extremity be somewhat greater by the weight-bearing method than without it. Each attempt to prove this, however, fails. In fact the real shortening, due to bone destruction by the weight-bearing method, is by no means greater than by the extension method; it is, however, obvious that the impairment of growth, the atrophy of bones and muscles, must be less by our method of treatment because the undisturbed functional use of the limb—as far as weight-bearing is concerned—is always assured. We have often the opportunity to examine patients treated by extension and we have by no means the impression that in these cases the real shortening is little or that there does not occur widening of the acetabulum or dislocation.



FIG. 10.

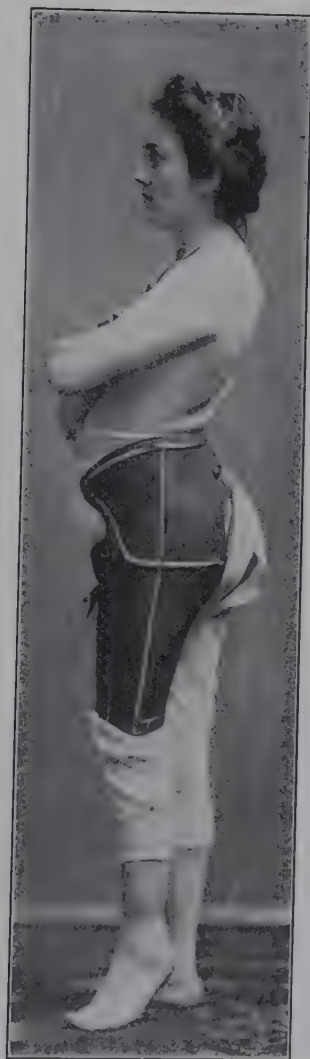


FIG. 11.

FIG. 10.—Ankylosis in flexion and adduction. Treated elsewhere.

FIG. 11.—Semicircular apparatus for after-treatment. After correction of the deformity subtrochanteric osteotomy.

In the further treatment, when all local manifestations of the disease have disappeared, we have the patient wear a leather splint made after the model. This is fundamentally different from the so-called Hessing apparatus, and is a common semi-circular apparatus, Fig. 11.

At the end of the treatment, therefore, the patient comes with a firm joint. The position, if the patient came under treatment early, is by no means so faulty as to necessitate correction. But even if treatment were begun later and deforming contracted positions were unavoidable, it is possible without the least difficulty to correct it, *vide* Fig. 10. In correction of these positions by subtrochanteric osteotomy, we lay great stress on completely dividing the bone, to obviate in any way loosening the union between pelvis and thigh. In these cases, where ankylosis is incomplete, we fear, in spite of osteotomy, the recurrence of adduction. The more movable the joint, the greater the danger. For these reasons we use in these cases, healed with motion, the splint shown in Fig. 12 with the Lorenz perineal crutch. During the phase in which the patient stands on his diseased limb the pelvis cannot drop down in the sense of adduction because he rides on the crutch.

With these simple means of mechanical treatment just described we believe we are able to do more for the patient than with complicated portable apparatus, or by extension in bed.

Our motto is: *Fixation of the diseased joint without distraction, and the weighting of the fixed joint if at all possible for the obtaining of a functional ankylosis.*

Perhaps some weight may be attached to these deductions by the fact that our observations cover a period of over fifteen years with about 800 cases of tubercular coxitis as forthcoming statistics of the Lorenz clinic will show.

We might also add that in our opinion weight-bearing by no means favors abscess-formation—on the contrary, we believe that our so conservatively treated cases show less tendency to suppuration. It is interesting to note that in those cases treated from the beginning of their disease there seldom occurs rupture and fistula formation. This is due to the fact

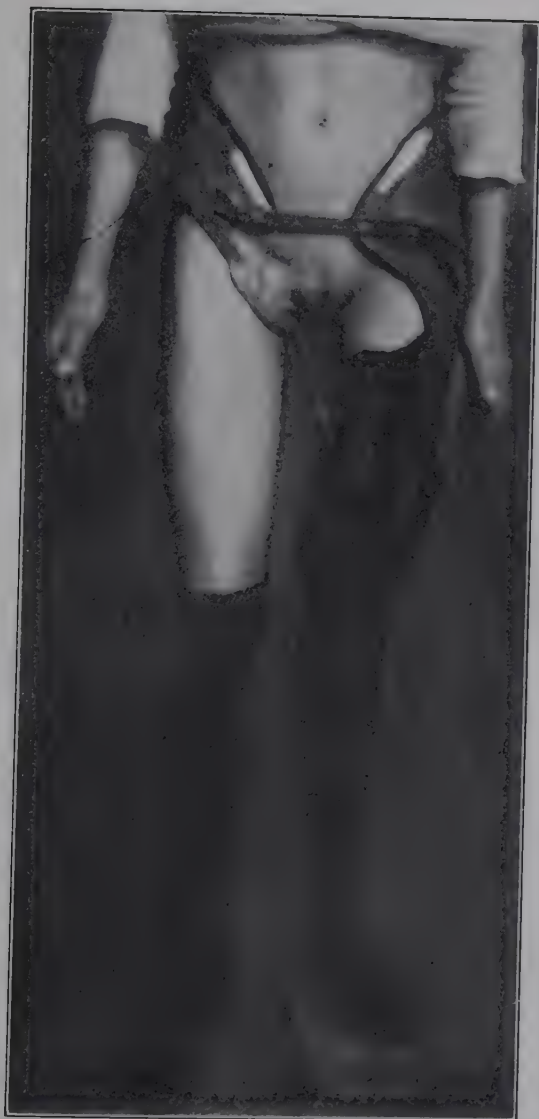


FIG. 12.—Lorenz perineal crutch.

that we never incise the existing abscess, but puncture it, and after puncture apply a plaster cast with compression. In this way the formation of a fistula is always hindered. The blessings of our strictly conservative treatment are great, and we can the better judge it as we also took part in the period of resections—a time when we also thought it possible to shorten the process by extirpation of the diseased tissues with a possible sparing of the healthy bone. We very soon gave up the resection treatment.

In accentuating the great success of the conservative treatment of coxitis, we must not omit to call attention to the importance of combining with the weight-bearing therapy all other modern means at our command in the fight against tuberculosis in general.

Among these, as my latest investigations show, the X-ray treatment promises excellent results in the purely synovial and beginning cases.

AN ORTHOPEDIC VIEW OF THE TREATMENT OF FRACTURES.

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In an article on fractures written by an orthopedic surgeon, it is natural that the subject should be treated rather from the point of view that every fracture is potentially a deformity, and if it becomes a deformity will lead to impairment of function.

The object of treatment is the restoration of complete function with least risk and inconvenience to the patient and with least anxiety to the surgeon.

In attaining this object a clear idea is needed of the disabilities and deformities most likely to occur after fractures in each particular region, and also of the difficulties in treatment peculiar to each.

The smooth working of a limb depends on preserving the true axis of movement of the joints, so that the stresses of muscular action may act across the joint in normal lines. Otherwise, abnormal stresses will produce abnormal strains for we are dealing with living bone, in accordance with Wolff's law, which is the physiological equivalent of that universal law: Strain is proportional to stress.

In dealing with fractures of the shafts of long bones the first consideration therefore is to secure and maintain a true anatomical alignment of the bone, so that the axis of movement of the joints at the two ends of the bone may retain their correct relative positions. The best results are naturally obtained when the fragments at the seat of fracture are brought into correct reposition. Experience, however, has proved that

meticulous exactness in replacing every fragment is not necessary to a perfectly good functional result.

In carrying out this principle of treatment every surgeon must frame for himself his own rules of procedure, being governed by his own experience of success with manipulative methods or with direct operative attack on the seat of fracture and applying splints immediately on the bone in the form of plates and screws. Those who have a large and varied experience of the manipulative treatment of deformity will probably have greater confidence in their ability to deal with deformities resulting from fractures by manipulation and external splinting. They will reserve direct operation for those cases in which they have found that their manipulative skill has not proved equal to retaining the limb in a correct position until union of the fragments has taken place.

In referring to particular fractures, the writer will therefore be drawing on his own experience with his own methods of securing that correct alignment which is the first object of every surgeon when called on to treat a fracture of a shaft of a long bone.

In this connection, it is not amiss to say that the virtue of a splint lies not so much in its particular form, but in the way in which it is used. At the same time every workman carefully selects the tools he uses and has his favorites among them. In this respect the author is conscious that he has his favorite splints, but believes that for the purposes for which he uses them, and in the way in which he employs them, they are the most suitable, most efficient and most immediately available that he can find.

It is sometimes stated that the object of a splint is to keep the parts immovable. While this is true, it is desirable to remember that the first object is to maintain the alignment. For this purpose the traditional wooden board, still often used, is not the best and is often a trap for the unwary practitioner. No human limb will fit a flat board. If a limb is bandaged to a flat board firmly enough to make it immovable, the parts above and below the fracture may easily be put out

of alignment. Of this, the treatment of fractures of the femur with the long Liston splint, has furnished many examples. A further objection is that a cylindrical limb only touches a flat splint along a line. Thus, if the bandaging be really firm there is a risk of undue pressure atrophy along this line. If thin metal is used (sheet iron of the same thickness as 24 wire gauge) this trouble is very largely overcome, and sheet iron can be got from the village smith as easily as a plank from the carpenter. Sheet iron of this thickness can easily be twisted or squeezed by hand to fit the varying curves of the limb, and yet being gutter-shaped, is quite rigid longitudinally. Further, having a curved cross-section and being slightly flexible, it distributes the pressure more evenly round the limb and not along a line. Hence the limb can be really firmly bandaged to the splint without fear of producing pressure sores. Of course in both instances the hollows in the limb must be suitably padded to avoid pressure on bony prominences, but in the case of thin metal splints this is much easier.

In dealing with fractures near joints or involving the articular ends of bones, difficulties of treatment are greater.

True alignment, especially of the axis of movement, is still of paramount importance, but there is also the difficulty that small fragments of displaced bone which would be of little importance in a fracture of the shaft, may here get in the way and effectively block movement by their mechanical obstruction.

The ends of long bones consist of cancellous bone containing red marrow. They are extremely vascular, and ready to undergo growth changes on very slight provocation, hence any conditions which maintain local irritation will tend to increase the amount of new bone formation with consequent obstruction of movement.

In purely traumatic cases these changes are known as traumatic osteoarthritis, but they arise chiefly from undue irritation by movement, occurring in the stages of repair. At this time, the area is more vascular than normal and the whole osseous structure of the part is therefore more susceptible to strains arising from stress of weight carrying. Examples of

this will be found notably at the ankle and hip. Another factor is the stress of muscular action which, of course, is a factor in all cases, but in the upper limb it takes precedence of gravity.

This leads us to the consideration of the fact that muscles and tendons cross the joint and are often attached to the ends of the bone near the joint. They may be the surgeon's worst enemies or his best friends in the treatment of a fracture about or involving a joint, according to whether he uses them correctly or wrongly. As an illustration of this point no joint serves better than the elbow. At one time it was customary to attempt treatment of fractures about the condyles of the humerus, which are so common in children, on a right-angled internal splint. Frequently the result was a "gun-stock" elbow with the lower end drawn backward, often also displaced outward by pressure of the splint on the internal condyle, while the lower end of the upper fragment of the humerus projected forward, helping with its associated callus to produce a complete mechanical obstruction to flexion. Here, once the backward displacement of the lower fragment has begun, the triceps tendon will keep pulling the olecranon back and up. Any play means a see-saw struggle between the biceps and brachialis anticus and the triceps, with a continuous slight irritation of the part and a maximum formation of exudate and of osteogenetic formation in that exudate.

Now that these fractures are almost universally treated in the fully flexed position, the tendon of the triceps forms a comfortable, close-fitting posterior splint, any fragments in front are pushed out of the way and mechanical block to flexion cannot occur. The joint can be kept at complete rest without any play and therefore disturbing reflex contractions of the muscles do not occur, and fractures of this type have ceased to have terrors for the surgeon.

When absolute rest from movement is to be insisted on as a condition necessary for reducing the formation of obstructive callus to a minimum, some rule must be formulated to guide the surgeon when movement of the joint is again to be resumed. Here the old rule laid down by Owen Thomas can be taken as

the first guide, namely, that a joint which is tender to palpation is not ready for movement. This tenderness means that excessive vascularity is still present in the bone, surrounding periosteum and tissues, and therefore that any attempt at movement will certainly injure the parts, producing fresh exudate and exciting increased formation of callus.

When this tenderness has entirely disappeared the joint may be moved through a small range of 5° or 10° . If this can be done without pain, a good prognosis may confidently be given. The patient may then be allowed to use the joint through a small range of movement, and if in two or three days the range of movement is increasing, then greater freedom may be permitted. If, however, the joint becomes stiffer and a little painful, then the time for movement has not yet come. A little later comes the time for passive movement. The indication for this is the belief that further movement is prevented by fibrous adhesions and shortening of ligaments. Passive movement should be done once in each direction in which movement is limited. It should not be followed by a reactionary swelling and stiffness which lasts for more than twenty-four hours. If the joint is stiffer twenty-four hours after a single movement it means that it is still not ready for movement, or the movement used has been too violent. To and fro passive movements are very likely to stir up a reaction of an inflammatory nature which leads to more effusion and more adhesions. In all such cases more time is lost by being in a hurry than by waiting a little longer than necessary before trying to restore motion.

So far we have said nothing of massage. At all stages of treatment we believe that massage is beneficial, provided it is of the lightest possible character and applied with skill without disturbing the fragments, or stimulating the young callus to fresh overgrowth. When in doubt on this point, it is certainly safer not to massage but to rely on absolute rest.

As we shall see when dealing with mal-united fracture, young callus is very susceptible to irritation by shearing forces. Continued pain and tenderness is the great symptom indicating that the repair has not been allowed to become firmly consoli-

dated before the stresses of muscular action or of gravity have been allowed to act on it thereby keeping up irritation.

NONUNION AND MALUNION.

It is true that there are certain conditions of disease and constitution which retard the union of fractures. The age of the patient is certainly not a direct factor in the production of nonunion, for the most perfect union may occur in the aged and feeble. Setting aside a few cases in which there is some actual condition of disease, experience shows that nearly all cases of "nonunion" are really cases of "delayed union."

This introduces the question of the time it takes for the fracture of any given bone to unite and consolidate. In textbooks of surgery definite periods are stated for each, but these are quite unreliable. The period necessary for the complete union and consolidation of a fracture varies in every individual and is a "personal equation" to which sufficient attention is not paid. Not only cases of nonunion, but as we shall see, cases of malunion are frequently due not to any fault in the method of setting or fixing the fracture but to the fact that in the individual patient union is slow, requiring twice or even three times the usual period.

Too often the practitioner is hasty in his judgments in this matter. The fracture he is treating shows no evidence of union at the time he expects it, instead of waiting for a week or two he proceeds to disturb the parts, rub the ends together and start afresh. Again at the appointed time there is "nonunion." When these cases are ultimately sent to consult the writer his usual practice is simply to begin again and wait. By this time there has been a great deal of fibrous repair, and osteogenetic repair has failed. The first thing, therefore, is to wake up the region of the fracture by rough handling to "freshen the ends" of the bone. In doing this, the procedure called "hammer and dam" by Owen Thomas is most effective. After hammering the whole region of the fracture with a padded or India-rubber mallet, a tight elastic band is applied both

above and below the fracture at a distance of several inches. This allows the limb in this part to swell to much more than its normal girth, expanding all the capillaries and lymph paths in the fibrous tissue and allowing a new process of repair to start.

This method of passive congestion was employed by Owen Thomas fifty years ago long before passive congestion as a means of treatment had attained its present prominence.

The fracture is set in the usual way and repair is expected in a longer or shorter time. In those cases where the processes of osteogenetic repair are naturally slow nothing is gained by operation, for even after plating the repair process is a delayed one.

In some cases of complicated fracture in which tissue has intervened between the fragments, open operation may be called for, but in the writer's experience the majority of cases of "nonunion" are really unrecognized cases of "delayed union."

Malunion is a large and difficult subject, and while some generalizations can be made, the exceptions are numerous. First of all there is a type of malunion which is closely related to the question of delayed union. A patient with a Pott's fracture receives skillful treatment, the foot is kept well inverted, at the end of six weeks repair in good position is pronounced complete. For six weeks the patient goes gently and then recovering confidence takes more violent exercise. After that he begins to complain of pain about the ankle and appears to be getting flat-footed. When the surgeon runs his fingers down the fibula he finds tenderness at the seat of fracture. The new bone or callus has been strained, a reaction has set in, the callus is soft and tender, the fibula is bending at the seat of fracture and the foot is being forced by body weight into the valgus position. All the treatment necessary is to invert the foot by raising the inner side of the heel of the boot, so as to alter the line of the body weight. If the patient is heavy it is as well to add an outside brace and T strap. This frequently occurs in adults, but its nature is not always recog-

nized. The same thing frequently occurs in children in fractures of both bones in the leg, but in this case the deformity is obvious. Similar straining of the union takes place in the forearm, leading to limitation in pronation and supination; also at the hip after fractures about the femoral neck often leading to obscure "rheumatic" pains. In every case the trouble is due to straining or shearing of the callus producing an erroneous alignment and throwing the joints out of true. Bearing these facts in mind, it is wise to protect a fracture, especially of the lower limb, from undue stress, even after it appears to be firmly united. On the other hand, it is to be remembered that physiological use is the best agent to assist in making the union solid. It is therefore good practice to let the patient walk as early as possible with a protecting brace for the leg (in a Thomas walking calliper if the fracture is in the femur) or if preferred in an ambulatory plaster splint.

There are other more gross cases of malunion which arise usually from failure to get the fragments into good position when reducing the fracture, or from failure to maintain the parts in good position after it has been reduced.

In some cases it is extremely difficult to get good position or good function on account of complicating injuries. Such cases must be met by the ingenuity of the surgeon as they arise. In consequence of this difficulty, there is a growing tendency to operate and plate fractures which seem to present difficulties. It must be remembered, however, that efficient bone operations require a considerable degree of special skill, and that an open operation over the seat of a fracture is necessarily a serious consideration to the patient.

It is possible to prevent many of the common forms of malunion with their associated disabilities, by anticipating them in the methods of setting. Some of these will be described in the brief survey of the principal fractures of the bones of the limbs which will be given in the end of this article. Many methods of manipulative treatment which are traditional can be improved on, and by improving our manipulative skill

and technic we may hope to frequently avert the necessity of operating.

Similarly it is to be remembered that tenderness at the seat of a fracture is an indication that the callus is not yet hard. It may therefore be broken down by manipulation and the deformity directly reduced, or it may be corrected by splints or by fixing the limb in a corrective position, just as one can correct a bow-leg or knock-knee by splints, or an active case of coxa vara by extension in the abducted position.

The time that has elapsed since the accident is no indication of the solidity of the union. If the seat of the fracture is tender the callus is soft. Usually the patient complains also that the deformity is growing worse, that is to say, the callus is yielding. If it can yield in the direction of deformity, it will yield with equal readiness in the direction of correction if proper forces are applied to it.

Turning now to a brief review of the commonest fractures:

Fractures of the Clavicle.—Fractures of the clavicle are generally well treated, for it is recognized that the general alignment of the bone must be well maintained by keeping the shoulder back and out. The bone is subcutaneous and the practitioner can see and feel the position of the fragments.

Fractures of the Humerus.—In fractures of the neck of the humerus the seat of fracture is deeply situated in muscles and we must be guided by experience.

Dissections and radiographs teach us that in malunions the upper fragment is frequently abducted and the lower fragment becomes united to its lower side. Clinical experience teaches us that the disabilities which are of greatest practical importance to the patient are limitation of abduction and of external rotation, so that he cannot place his hand at the back of his head.

In reducing this fracture it is often useful to have an assistant extend the limb downward till the fragments clear, then outward to a right angle with the body, and even straight upward by the side of the head. Meanwhile the surgeon with his hand in the axilla and on the arm can feel that the rough broken surfaces

have engaged. The arm can then be gently brought to the side, and the arm fixed to the side in the usual manner. There seems to be little fear of the ends disengaging once they are properly apposed.

When union is sound, passive abduction and rotation once a day will soon reestablish a full range of movement.

When a case comes to me with a stiff shoulder and a limited range of movement, I place more reliance on passive movement, breaking down adhesions first under an anesthetic if necessary.

After fracture of the neck of the humerus, forcible breaking down of adhesions in the shoulder-joint should not be attempted for at least three months, as refracture may occur. During the operation the surgeon should remember that the movement most dangerous is not flexion, but internal and external rotation. In the meantime, an assistant should hold his fist firmly in the axilla to prevent dislocation.

In addition to his daily passive movements, he should practise reaching up the wall with his fingers, making a mark each time at the limit of his stretch and being careful to surpass it at his next attempt. I have been much struck by the extremely serviceable range of movement obtained by these means.

The so-called fracture of the surgical neck which usually includes both tuberosities with the head is really less troublesome. It occurs usually in old people and is often impacted. In these cases the arm may be left quietly by the side and a very useful range of movement can be obtained by exercise and passive movement later.

Fracture of the surgical neck complicated by dislocation is much more serious. The maneuver which I have found most useful is that already described of having the arm stretched straight upward by an assistant while the surgeon endeavors to manipulate the head back into position. If this fails, operation may be resorted to, and McBurney's hook is of great service in twisting the upper fragment into place.

Fractures of the shaft of the humerus may be troublesome from two causes—either on account of damage to the musculospiral nerve through injury or inclusion in callus, or due to

nonunion, the latter being generally caused by inefficient fixation. Many cases of supposed permanent damage to the musculospiral nerve are cured in a few weeks by application of a splint which holds the wrist in dorsiflexion. The patient generally goes about from the beginning of treatment. There is not room for the thick splint frequently employed to lie comfortably in the axilla between the patient's arm and the body, and hence the arm is not as firmly fixed as it should be. Sheet metal splints occupy very little space. The best method I know of setting these fractures, especially when working single-handed, is the following: First get ready three sheet-metal splints. The external one extends from the external condyle to well above the shoulder and its upper end is bent over to form a sort of shoulder cap. A short splint extends from above the internal condyle to the anterior fold of the axilla, and a similar posterior one to the posterior fold of the axilla.

Flex the elbow to an angle of about 60° and sling the wrist to the neck, with the patient sitting in a chair. A loop of bandage is put round the flexure of the elbow and does not reach the floor. By putting one foot in this loop, the surgeon can apply as much extension as he chooses, while both hands are free to manipulate the fractured ends into correct position. The splints are applied and squeezed up till they fit closely around the arm. A turn of sticking plaster now binds them into a cylinder fitting the arm. A sheet of wadding is then placed between the arm and the chest. The whole is secured with a broad bandage carried over the shoulder and the part of the external splint which is turned over like a shoulder cap. This prevents shortening, for the lower end of the cylinder fits round the arm above the condyles.

As the whole arm is in a close-fitting cylinder displacement cannot easily take place, and the patient is quite comfortable.

Except to free the musculospiral nerve from callus operation is rarely necessary, for even if there is some overriding of fragments a little shortening of the arm does not give rise to any serious impairment of function to the ordinary man.

All fractures through the condyles and indeed all fractures about the elbow, except fracture of the olecranon, are best treated in the fully flexed position. For the first few days the forearm, fully supinated, should be bandaged to the upper arm in fullest flexion, after this it is sufficient to keep the wrist slung short up under the chin.

In dealing with cases of stiff elbow after fracture through the condyles, especially in children, even if there is backward displacement of the lower fragment, I always first attempt to secure full flexion.

Under an anesthetic, with the humerus and forearm protected by local plints, the elbow is forcibly flexed, breaking or twisting the recent callus. The arm is then bandaged in the most flexed position obtainable. It is a remarkable fact that callus in front of an elbow-joint when subjected to continuous pressure in this way is rapidly absorbed, so that in a few days the elbow can be further flexed.

If necessary, the process may be repeated a second or third time till nearly complete flexion is obtained. The elbow is then left fully flexed till all reaction has disappeared. Then a gradually increasing range of movement is permitted, as has been already described.

Of course this treatment is not applicable to a case with actual bony ankylosis between the humerus and bones of the forearm, but such ankylosis is really very rare. If you can once get the callus on the move the progress toward recovery only requires about six weeks in the majority of cases.

In fractures of the shafts of the bones of the forearm the chief disability to be feared is inability to supinate the forearm completely. The trouble usually arises when both bones are broken. Here anatomical knowledge is of importance. The whole length of the posterior border of the ulna is subcutaneous and is practically straight. On this straight ulna the curved radius rotates like the handle of a bucket.

We must therefore attend to two points. First we must keep the ulna straight, second, we must not interfere with the natural curve of the radius. That is to say, there must be

no pressure of bandage or splint on the middle of the shaft of the radius.

With anterior and posterior wooden splints, the middle of the forearm is often allowed to sag into a curve. Once the ulna is allowed to bend, both upper and lower radio-ulnar joints are thrown out of line. With gutter-shaped metal splints, which wrap themselves round the limb, the arm can be fixed with the ulna lying straight along the posterior splint and the radius will almost take care of itself so long as it is free to take its natural curve. This can be secured by fixing the splints at their two ends, at the wrist and elbow. When union has taken place, see that supination is possible before the callus is too hard to be twisted.

No mention is made of muscular action, because I hold that it is merely a reflex called forth by shifting of the parts. If the forearm is comfortably fixed in splints and slung across the body at right angles to the arm, there will be no reflex muscular spasms. This question of muscular spasm will be dealt with more fully when dealing with the femur.

Movement of the fingers in forearm fractures seems to do good and not harm. It does not disturb the relations of the fractured bones, and provides a healthy physiological stimulus to the circulation and general trophic condition of the limb. In fact, if the patient cannot move his fingers without discomfort, it may be taken as an indication that there is something wrong. The surgeon should then ascertain if his alignment is faulty or if there is undue pressure.

Colle's fracture and Chauffeur's fracture, with or without fracture of the styloid process of the ulna, should give no trouble provided two things are attended to—first, the reduction of the displacement, and second avoidance of strain of the callus by injudicious passive movement. The lower end of the anterior aspect of the radius is concave, with a very pronounced curve toward the prominent anterior edge of the lower articular surface. This curve must be preserved or the joint will be out of alignment, and the patient will complain of pain and stiffness until nature has had time to make necessary readjustments.

After reduction, a good anterior pad of wool is placed in the concavity of the radius already referred to, a similar posterior pad is placed on the dorsum of the wrist-joint and carpus, rather to the radial side. Firm pressure on these two pads maintains the correction.

Using sheet-metal splints the author puts a spiral twist on each. For the right arm the dorsal splint is twisted a half turn with the clock and the anterior splint a half turn against the clock. The lower end of the anterior splint should stop short with the radius and must not encroach on the thenar eminence. A turn of sticking plaster at the wrist secures the two parts in position. A second turn near the elbow secures the other ends of the splints near the elbow. The dorsal splint need only extend half way down the dorsal aspect of the metacarpals. A bandage over all makes everything secure. The patient should be encouraged to move the fingers from the first. If this be impossible the surgeon should find out why.

The splints may be left on for five weeks, for instance when a pretty result with a minimum of callus is desired in a lady's wrist. If the fracture is properly set, there is no fear of a stiff wrist.

In the author's experience, stiff wrists after Colles' fracture are due to two causes: incomplete reduction and injudicious movement producing strain of young callus. Patients with a Colles' fracture often imagine they have "only a sprain," go home and apply cold water bandages for a day or even two and then go to the surgeon with a painful swollen hand and wrist. When one of these cases appears lose no time, massage away as much of the swelling as possible and reduce at once. Delay only means increased difficulty in complete reduction, and the probability of more trouble from stiffness afterward.

The next point is that early passive movement of the wrist—not of the fingers—is apt to mean disturbance of the area of repair, and further reaction with pain and increased stiffness.

Cases with stiffness of the wrist and pain on any attempt at passive movement come for advice three to six months after the accident. There is a history that in spite of the most assid-

uous efforts to restore movement, the wrist has remained stiff and painful, and that the more it is moved the worse it is. In these cases a careful examination will nearly always reveal the fact that the deformity is not reduced. The presence of pain and reaction after movement is proof that the callus is still in an irritated or active condition and cannot be very hard. In such cases the author reduces with a Thomas wrench, applying the jaws of the wrench just as he would have applied his own scaphoids had the case been a recent one. This operation can be done under gas. Incidentally adhesions are broken down and the fact that, when the patient wakes up with splints on, he can move his fingers as he could not do before, is a great encouragement to him.

There are other cases of malunion after a Colles' fracture of older standing, in which all pain at the seat of fracture is gone. The callus is solid but the patient cannot use his hand well. In these it is generally found that the patient cannot dorsiflex the wrist and therefore the grasp of the hand is feeble. Such cases should be treated like cases of fracture of the carpal bones—by restoring dorsiflexion.

Fracture of Bones of the Carpus.—In the carpus, the bone most frequently fractured appears to be the scaphoid. Clinically the case appears at first to be a bad sprain. A diagnosis may be made, however, by the acute tenderness on pressure in the "anatomist's snuff-box."

The great disability complained of after this and similar injuries is stiffness and weakness of the fingers. On examination this is found to be due to inability to dorsiflex the wrist. Every schoolboy knows that the grasp of the hand is weakest when the wrist is flexed and strongest when it is dorsiflexed, but surgeons have been strangely slow to put this knowledge to practical use. Stiff wrists are nearly always slightly flexed wrists, therefore the treatment is clearly to keep the wrist quiet in dorsiflexion till the storm is passed.

Having diagnosed a fracture of a carpal bone, the writer always dorsiflexes the wrist and puts it up in this position on a palmar splint of sheet metal, known for many years in Liver-

pool as the "cock-up" splint. If a fragment of the scaphoid is displaced backward and obstructs dorsiflexion, he first tries to press it back into position and then dorsiflexes the wrist. If this fails, the fragment should be removed at once and the wrist put up in dorsiflexion. In cases of fracture the splint need not extend beyond the palm, the fingers being free.

In cases of stiff wrist with an inflammatory element, the palmar part of the splint should extend to the tips of the fingers until the inflammation has subsided.

As has been already indicated this treatment will increase the range of movement and improve the function of the wrist in certain cases of stiffness after old-standing Colles' fracture.

Fractures of the Lower Limb.—In dealing with fractures of the lower limb, especially with fractures of the femur, muscular action has always been a disturbing factor, tending to produce shortening and over-riding of fragments.

Let it be said at once that the writer never employs weight and pulley extension. Extension by weight and pulley is a most inefficient method of attempting to control muscular spasm. It is by reflex nervous impulses induced by changes of tension in the muscle, that muscular spasm is produced. A patient lying in bed with a fractured femur cannot avoid constantly changing the state of tension of the muscles of his thigh if he has a weight and pulley attached to his limb. The counterpoise is the weight of his body. Every time he tries to shift the position of his shoulders by digging his elbows into the bed, he alters the tension on his muscles calling forth a reflex spasm. When he falls asleep and his muscles relax, when he moves in his sleep, when he is lifted upon a bed pan, or moved slightly by the nurses to have his bed put straight, there must be a reflex contraction of his muscles because there is a sudden change in tension. The muscles are always on the alert. Liston with his long splint used a perineal band and fixed the ankle down to the lower end of the splint. This form of extension was absolutely sound in principle, but was abandoned because the perineal band chafed and made the groin and perineum sore. The real reason for

this was that the perineal band was cloth, absorbed perspiration, and became septic and irritating.

Nevertheless the best method of fixing the thigh is by fixed extension such as Liston used, only the method can be much improved on. To illustrate this point consider a fracture of the middle of the shaft of the femur, with extension strapping of adhesive plaster applied in the usual way to the sides of the limb right up to the seat of fracture. At the lower end of the extension strapping there is a loop of webbing to which is attached a length of strong bandage, or better still of ordinary lampwick. Next slip the ring of an ordinary Thomas knee splint over the foot and up to the groin till it is firm against the tuber ischii; pull the extensions tight; take a turn round each side bar; and tie the ends together over the bottom end of the splint which of course projects 8 or 10 inches beyond the foot. For further control, place behind the limb a gutter-shaped sheet-metal splint extending from the buttock fold to the lower third of the leg with a good wool pad in the hollow of the knee. On the front of the thigh place another sheet-metal splint stopping short above the patella, and fasten the two together with a couple of circular bands. This gives excellent local control for the sheet-metal splints, each embracing nearly half the circumference of the limb. A couple of little transverse bandage slings suspend the posterior splint from the side bars of the knee splint, so that the center of the limb is exactly between the two side bars. The alignment from hip-joint to ankle-joint is perfect, being dependent on a straight pull.

Now the patient may raise his shoulders. His other leg can even be moved without altering the tension on his thigh muscles, and there is no reflex spasm of the muscles. Further, even if the muscles try to contract they cannot, for the upper end of the splint is firm against the tuber ischii. The muscles, therefore, do not remain on the alert, but come to rest. Starting pains are unknown.

A little attention is necessary to prevent soreness of the perineum. The ring of the splint is covered with leather, a wipe with a soapy rag slipped between the splint and the skin keep

both clean and polished. Finally the nurse must several times a day press down the skin of the buttock and draw a fresh part of skin under the splint. After a few days the patient becomes so used to the splint that this is no longer necessary, but with a very fat flabby patient, the skin may begin to show signs of redness in half an hour and should therefore be attended to every half hour for the first day or two.

Having obtained the full length of the limb, all that is needed is to keep the extensions taut. This is a very different thing from hanging a weight of several pounds on to the limb to tire out the muscles.

All that is necessary is to prevent them from contracting. If a muscle has no play it is not nearly so ready to respond to reflex impulses as a muscle which is under elastic tension.

In a straightforward case where all the shortening has been corrected when the fracture was set, or within a day or two by tightening the extensions as the muscle relaxes, there is nothing more to do until the end of the fifth or sixth week by which time fair union has taken place. Now a walking caliper a quarter of an inch too long for the limb is substituted for the bed splint, and the patient is allowed to walk. As the splint is just a shade longer than the limb he cannot quite get his heel to the ground and therefore is not really carrying weight. Swinging the limb along improves its nutrition, and generally aids in hastening the process of repair, for it is a modified form of the normal physiological function of the limb.

In dealing with malunited fractures of the shaft of the femur the same method of splinting is employed. First, however, there is the question of how to get rid of the over-riding. If there is tenderness and pain at the seat of fracture, especially if the deformity is increasing, it is quite safe to conclude that the callus is still soft even though many months have elapsed since the accident. In such a case by twisting and manipulating the limb the callus can be broken down. Then with block and tackle the muscles can be forcibly stretched as much as 2 inches or rather more at one sitting. The limb is then put up in the manner described, with fixed extension. Next

day or the day after, the muscles will be adapted to their new length and by tightening the extensions an overlapping of 3 or 4 inches can readily be corrected in a few days and the limb made nearly if not actually as long as its fellow. At the same time with this straight pull, any angular deviations out of the true line are automatically corrected.

To deal with such cases, it is convenient to clip on to the bottom of the Thomas splint a small apparatus which consists of a central screw bolt at the end of which there is a little swingle bar to the ends of which the extensions are attached. As the muscles relax the nurse gives a turn to the screw and keeps the extension taut, in this way the muscles never get an opportunity of shortening, and it is astonishing to see how rapidly they relax. With this method one relies more on preventing contraction than on actually stretching the muscle by force except of course the pulling when the patient was under an anesthetic. That is very forcible. A good start means a great deal but once the bone is started to move, it can be continued without much trouble.

In cases where the callus is already solid, I operate with the limb forcibly stretched with block and tackle, endeavoring to correct the whole of the shortening there and then. If it is possible to get the whole of the shortening reduced at once, of course the next step is to fix with plates and put the limb up as already described.

Fractures of the neck of the femur are treated in a different way. The great deformity to be feared is that produced by the shaft travelling upward past the head and neck. Experience has proved that to avoid this varoid deformity the fracture should be treated with the limb in the abducted position. For this purpose, a double Thomas hip splint with the leg piece abducted is very convenient. The splint is fitted with extension bows. That is, a bow exactly like the lower end of a knee splint is attached to the ankle wings of the splint. Counterextension is by a groin strap well padded and covered with leather. This is usually put on the opposite groin, partly to avoid having pressure near the injured hip, partly because this allows the

pelvis to tilt a little toward the injured side and so give a greater degree of abduction.

This apparatus and position are applicable to the treatment of all fractures above the trochanter minor whether in children or adults, of coxa vara in the active state, and of tuberculous disease of the hip. In fact, it is the position in which to treat any condition in which an adduction deformity at the hip is to be feared as a result.

It is equally suitable for the fracture of the femoral neck which occurs in infants as an obstetric injury, for the separation of the epiphysis of the head of the femur, for the strains of the neck which occur during school life, and for the so-called extra-capsular fracture which occurs in young adults. It is also suitable for the treatment of intracapsular fracture in the aged, provided the patient can stand the recumbency and restraint. The least sign of hypostatic pneumonia is an indication for abandoning this method, putting the patient in a Thomas knee splint propping him up well or even getting him out of bed and making the best of the fracture. Even under these unfavorable conditions these patients can get about wonderfully well in a walking calliper even if union should fail.

The fracture in young adults is usually caused by direct violence applied to the trochanter major. It is associated with splitting and broadening of the trochanter, and often is impacted. The question of disimpacting these fractures has been much discussed. My practice is to disimpact before setting if there is rotation or if there is any material shortening. Rotation outward of the foot is a much more serious deformity than a little shortening. If the foot is in good position without any outward rotation and the shortening is not more than might reasonably be expected in any case, then it is not necessary to disimpact.

As already stated, I treat all fractures above the trochanter minor in abduction and all fractures of the femur below this point on a Thomas knee splint. The alleged disturbing action of the psoas muscle in my experience does not occur. This is to be attributed not necessarily to errors of observation on the

part of those who report it, but to the fact that with fixed extension, reflex contractions of muscles do not persist. I do not believe that the desire to contract, unless it is oppressed, is as inherent in muscle as if it were original sin. My whole experience in the treatment of fractures, as in the treatment of such conditions as spastic paralysis, is that if muscles are efficiently controlled they come to rest and cease to struggle, but that if the control is inefficient or intermittent then reflex action is active and all muscles enervated from the same region of the cord share or less in the excitability.

Similarly it is my experience that in supracondylar fracture of the femur the lower fragment is not flexed by the action of the gastrocnemius after the first twenty-four to thirty-six hours, provided the limb is efficiently controlled. One of my former house surgeons has told me of a case in which he had direct ocular proof in a case of compound fracture in which the bone was exposed. He saw the bone gradually return into line with the femur by the end of the day after the accident. After this the wound began to granulate and no more was seen of the bone. The functional result was excellent.

Of fractures of the leg there is little to be said until the lower fourth of the leg is reached. Fractures above this are comparatively easy to handle, even if both bones are broken, but in my experience fractures of the lower fourth of the tibia or of both bones in this region are extremely difficult to control even if the tendo-achilis be divided. The slightest error of alignment may mean constant pain and weakness in the ankle for months afterward.

Although I approach most other fractures with a feeling of confidence that I can treat them successfully by manipulation, I feel that in fractures of the lower fourth of the tibia and fibula operation is usually the wisest course for me. My usual practice is to attack the tibia. If it is secured with plates and screws the fracture of the fibula can usually be dealt with by manipulation.

I have frequently seen a wedge of bone knocked off the anterior and outer part of the lower end of the tibia. This may occur

by itself or as a complication of a Pott's fracture. The detached fragment is liable to slip down a little and block dorsiflexion and therefore interferes with walking. The treatment in the first instance is to get the foot into extreme dorsiflexion thus pushing the fragment out of the way. If the foot is fixed in this position for a few days the condition will not recur. In old-standing cases, the patient comes with a history of an injury to the ankle or of a fracture in that region, and complains of pain over the front of the ankle-joint. On inspection the foot seems rather fuller than its fellow in this region. The X-ray photograph shows some irregularity of outline chiefly due to irritation periostitis. The treatment is to operate, removing the offending portion of bone and making sure that the foot can be completely dorsiflexed. If the patient declines operation, then the only thing to be done is to raise the heel of the boot so that the front of the astragalus does not impinge on the front of the tibia when walking.

There has recently been a great revival of interest in the treatment of fractures, stimulated by the revelations made by radiography, by the comparative impunity with which modern operative procedures can be attempted and by a growing dissatisfaction with the functional results frequently obtained by traditional methods of treatment.

In a single short article it is manifestly impossible to do more than touch on the fringe of so vast a subject.

The question before the modern surgeon is not whether operative treatment is to supersede manipulative. The problem before each of us is how can we improve our skill and technic in both manipulative and operative treatment, and what means must we adopt in each individual case to give to our patients the surest, safest, and most complete restoration of function?

RADIOGRAPHY OF THE VERTEBRAL COLUMN IN PROFILE IN POTT'S DISEASE.*

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In addition to the radiograph taken in front, with the patient lying on the back, we have used for two years at the Maritime Hospital and in our private practice the radiograph taken in profile of all our patients with Pott's disease. We should like here to show everything of interest, as much from the clinical point of view as from the therapeutic and prognostic. Thanks to these radiographs, indeed, one can track out a lesion from the very beginning, follow it in its evolution, determine exactly the most useful orthopedic attitude, and finally know when definite cure is obtained.

I. *Diagnosis of Incipient Pott's Disease.*—The diagnosis of Pott's disease is, in the great majority of cases, established too late. The kyphos is the indication of a lesion already advanced. Between the onset of Pott's disease and its first clinical manifestations there exists a long phase of latency, during which the lesions, under the influence of weight and muscular contraction, become aggravated. It is, then, in the interest of the patient to establish an early diagnosis.

It is true that, as in coxalgia, the symptomatology in the beginning is baffling. Before the kyphos, before even the generalized contracture of the vertebral column (revealed by the classic test of making the patient pick up an object with-

* This is the first in a series of four articles to appear in this Journal in 1913-14 by our French colleagues.

out bending the knees) a careful examination would reveal, or at least permit one to suspect, a vertebral osteitis.

With some, a scarcely evident contracture, localized in a segment of the spine, partial in character, does not prevent the patient from stooping to pick up an object; a slight diffi-

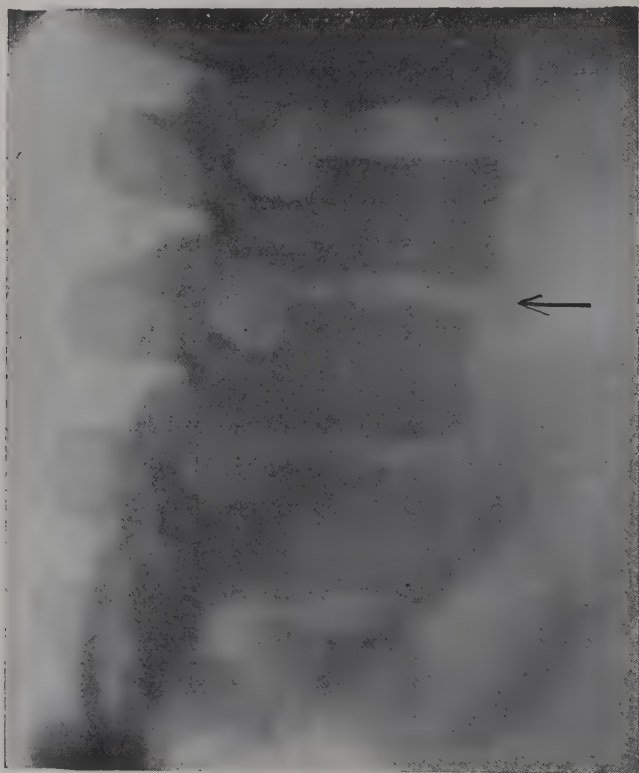


FIG. 1.—Radiograph of beginning Pott's disease. Thinning of an intervertebral disc.

culty in gait, an exaggeration of the reflexes with others, or a bilateral sciatica, etc., are the signs which ought to draw attention to the spine, but they are not presumptive signs. The radiograph taken in profile in such cases carries weight and certainty. One finds constantly if Pott's disease exists a very clearly marked thinning of an intervertebral disc. Fig. 1

is the radiograph of a child in whom, from the clinical point of view, there was no other sign than a slight limitation of extension of the lumbar spine, flexion being made normally. The diagnosis of vertebral tuberculosis made after the radiograph was taken, which indicated a thinning of the intervertebral disc situated between the third and fourth lumbar, was confirmed by a radiograph taken twelve months afterward, in which the osseous destruction was manifest (Fig. 2).



FIG. 2.—Radiograph of the same patient a year afterward. The disc is entirely destroyed. The vertebra underneath is in part destroyed and encloses a sequestrum.

II. *Study of the Kyphos*.—The profile radiograph permits one to follow step by step the formation of a kyphos. When the osseous destruction is sufficient, the vertebral column breaks (a true pathological fracture); the two fragments are held behind by the ligaments and muscles which unite the laminae and the spinous apophyses, and especially by the capsule and the ligaments of the posterior vertebral articulations. These various means of union, especially in the be-

ginning, oppose themselves to all displacement *en masse* of the fragments either in front or behind, but by their very physiologic function they do not oppose themselves to either a tipping movement forward or to a settling movement behind. It may be interesting to refer here in a few words to a point of normal physiology, on which one of us has for a long time insisted in his thesis,⁽¹⁾ and which aids in understanding cer-

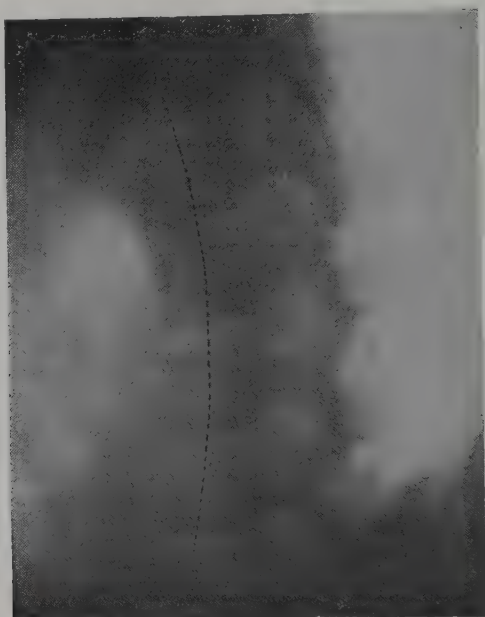


FIG. 3.—Radiograph of a vertebral column (lumbar region) in extreme flexion. The dotted line shows the "neutral line."

tain peculiarities of mechanism by which the kyphos is produced and also permits one to draw some interesting deductions from a therapeutic point of view.

When the normal vertebral column is placed in extreme flexion (Fig. 3) various modifications are produced, which the radiograph in profile shows perfectly.

1. The intervertebral discs are settled in their anterior portion in consequence of the pressing together of the vertebræ.

2. The spinous apophyses are separated from each other noticeably.

This double movement has its principle seat in the posterior vertebral articulations where the surfaces slip over each other and up and down. They are not then, as has been wrongly said, a pivot around which is made a tipping movement. Where, then, is the axis of this movement? It is sufficient to examine closely Fig. 3 to determine the situation. The intervertebral disc, diminished in height, pinched in front, is increased in height and widened in the posterior portion. It is



FIG. 4.—Vertebral column (lumbar region) in forced lordosis. Neutral line dotted.

easy to deduce that in a portion which it remains to determine in this motion of extreme flexion, it is neither compressed nor distended, forming thus the center of this slipping movement of the articular apophyses, one over the other.

If this question arises in the case of a vertebral column placed in hyperextension, in forced lordosis (Fig. 4), it is

equally easy to determine that the same region of the intervertebral disc is no more compressed than distended, as well in extreme extension as in extreme flexion, and if after having determined the neutral point of each intervertebral disc, each of these points is joined by a fictitious line, called by one of us the neutral line, there is a true geometric figure made of all the points of the vertebral column which sustain in the principle movements of the spine the minimum of pressure.

What are the deductions which may be drawn from this neutral line in Pott's disease from a pathological point of view?

The work of Lannelongue has made known the very considerable rôle which is played by the pressure, one against the other, of two osseous surfaces impaired by tuberculosis from the point of view of their reciprocal destruction. He has called it "compressive ulceration." When, in consequence of the destruction of the intervertebral disc, and under the action of the weight and muscular contraction, the superior fragment is inclined forward, it is capable of exercising considerable pressure on the inferior fragment. According to what we have said above, this pressure will be exerted only in front of the neutral line, and it is only in this portion that destruction will take place. Each of the vertebræ in contact will be worn out progressively, but unequally, in such a way that they take on a cuneiform appearance (Fig. 5).

The height of the anterior border of the impaired vertebræ gradually lessens, until complete disappearance takes place. This wearing process has as its direct consequence the increase of the flexion and consequently of the kyphos. Localized in the anterior portion of the vertebræ, it contrasts with the integrity of the posterior portion situated behind the neutral line; the posterior border retains almost completely its normal height; if one does not intervene with appropriate treatment the same causes are always operative; the pressure of the superior fragment continues to be exerted on the anterior portion of the inferior fragment. It decapitates, so to speak, the last vertebra of this fragment, penetrates the underlying vertebra (see Fig. 6), progressively wears out the anterior portion of

this one, and as the flexion reaches almost a right angle, becomes perpendicular to the axis of the inferior fragment.

At this phase of the destruction, an aggravation of the kyphos is produced by the following mechanism:

The superior fragment no longer being held in front, becomes



FIG. 5.—Pott's disease where the initial symptoms go back more than two years. Shows cuneiform disposition of focus, absence of consolidation and of osseous neo-formation. A compensatory lordosis is beginning to form under the focus.

more bent, and by means of an actual slipping its anterior aspect comes into contact with the superior aspect of the inferior fragment (Fig. 7), occasioning thus an extreme inflexion and a considerable kyphos.

III. *Study of the Treatment.*—Is it possible to combat such a

deformity? Can one prevent it, or if it exists, can it be corrected?

We have described in another place⁽²⁾ the treatment of Pott's disease, and we shall insist here on certain points which the radiograph in profile permits one to state precisely, and on which it gives information of considerable practical importance.



FIG. 6.—Pott's disease insufficiently treated. Shows that the superior fragment has decapitated the first vertebra of the inferior fragment and penetrated into the anterior part of the underlying vertebra.

1. Before the kyphos.

That which has been said before concerning the neutral line, and which shows so clearly, the examination of Figs. 3 and 4 explains sufficiently without making it necessary to insist further on the need of putting the affected portion of the spine in

lordosis in such a way as to prevent the anterior wear and tear, annulling the effect of the compression phenomena in front of the neutral line.

2. When the kyphos exists the problem is double:

(a) It is necessary to prevent aggravation of the difficulty. It is evident that for the same reasons the lordosis is sufficient to accomplish this purpose.

(b) It is necessary to correct it. Mr. Ménard in his treatise(3), "A Clinical Study of Pott's Disease," based on the examination of numerous anatomic specimens, has established certain fundamental rules which have been often disregarded. The radiograph in profile precisely confirms these.

Pushing the comparison of Pott's disease with traumatic fracture to an absurd length, it has been said, and is still said, that to correct a kyphos it is sufficient to replace the two fragments, separating them from each other in front, either by a forcible replacement under anesthesia or by a slow, progressive redressment; between the two fragments thus separated there would be established osseous bands of neo-formation, a callus, an outline of a definite solid ossification.

Nothing is more simple to conceive; in reality nothing is more false. A long time ago Mr. Ménard affirmed that osseous tissue affected by tuberculosis is never restored from the bone. He asserted that if the two fragments are separated and maintained in that position by methods of reduction (corsets, plaster, etc.) that when these supports were taken away the two fragments would again come in contact and the kyphos form again. Certain clinical facts seem to demonstrate this: the radiograph in profile proves it decisively.

In none of the cases here cited there can be seen a trace of osseous neo-formation or hyperostosis (Figs. 5, 6, 8). We have followed in the Maritime Hospital some cases in which we have provoked a separation of the fragments, and notwithstanding the lapse of a considerable length of time (several months), there is not even the outline of the formation of an intermediary callus. One has the impression that if the vertebral column were not retained in plaster of Paris that the angle

of inflexion would be produced again immediately. We will publish a report later.

It is not, then, the opening of the focus that is in question; it is in provoking the settling down of the focus itself on one side and of compensating lordoses above and below this focus,

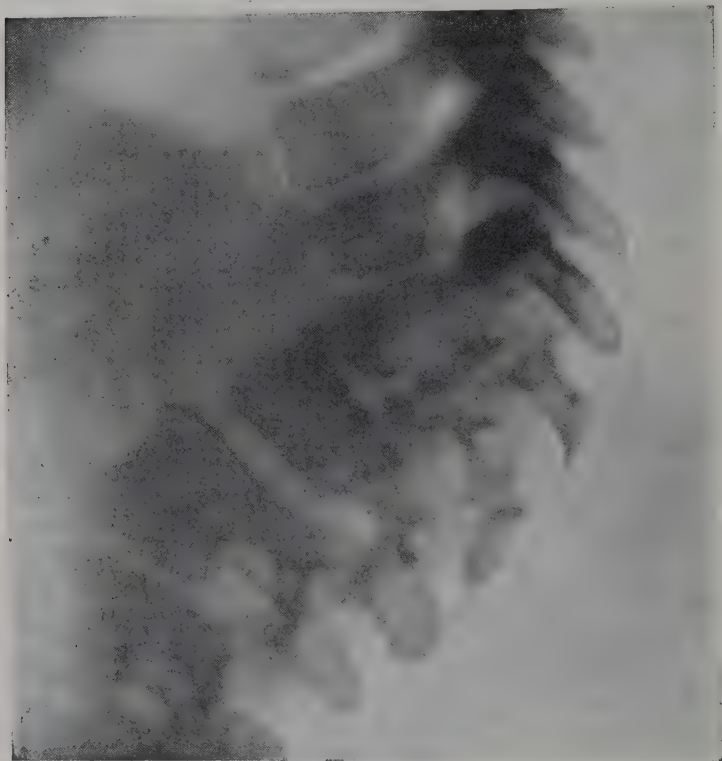


FIG. 7.—Untreated Pott's disease. Kyphos considerable through slipping of the inferior fragment in front of the superior fragment. Three vertebræ are destroyed.

so that one will bring to pass as soon as one sees the radiograph in profile the correction, or at least the compensation, of a recent kyphos.

(a) Posterior settling down. In posterior settling down it is necessary to understand the bringing together on a level with the kyphos of the spinous apophyses, without the two frag-

ments being separated, nevertheless, in front. The affected vertebræ in their posterior portions, remaining high, oppose each other. If one provokes a progressive lordosis one relieves, as we have already seen, the anterior portion, and moreover, according to the disposition of the neutral line, one establishes a strong pressure of the posterior portions of the vertebra one on the other, and therefore by compressive ulceration, diminution in height of the vertebral bodies in their posterior portion and possibility of bringing the spinous apophyses together; the vertebræ, on account of destruction, change their shape; from cuneiform they become rectangular, the diminution in height having a tendency to equalize them in front as well as behind. It produces a slipping up and down of the posterior articular surfaces on each other; the superior fragment tips backward, and consequently the kyphos diminishes; moreover, the hyperextension prevents the slipping of the superior fragment as we have seen produced above. Therefore, in equal numerical destruction (three vertebræ), but thanks to a more extensive distribution of this destruction, the attitude is better and the kyphos less (compare Fig. 7 with Fig. 8).

(b) Compensatory lordoses. We will not describe here the way to obtain these (see *loc. cit.*); we will only call attention to the fact that these will be more efficacious as they are developed as near as possible to the focus, immediately above and below.

Radiograph Fig. 9 shows the mechanism of their formation; separation of the vertebral bodies in front by distention of the intervertebral discs; slumping of the same vertebral bodies behind by the settling down of the discs; slumping of the pedicles and the spinous apophyses; close contact throughout their whole extent of the posterior articular vertebral surfaces.

IV. *Study of the Prognosis.*—(a) Extent of the focus. The radiograph in profile permits one to count the number of vertebræ affected or destroyed. It determines exactly the limits of the focus, and shows from an orthopedic point of view that the gravity of a Pott's disease is not only measured by the function of the number of vertebræ destroyed (see Fig. 7 and Fig. 8), but depends also upon the treatment applied.

(b) Duration of Pott's disease. Here too, thanks to the radiograph in profile, is confirmed a fact which Mr. Ménard has had the great merit of pointing out, the importance of which is considerable. That a focus of Pott's disease does not show a trace of cicatrization before two or three years; this only begins

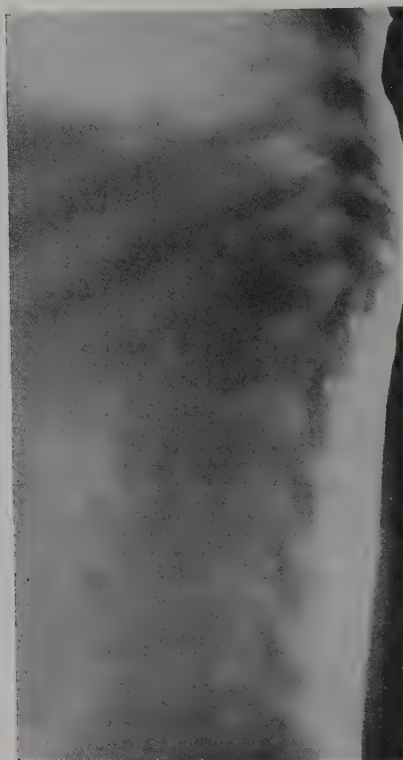


FIG. 8.—Pott's disease rationally treated. Three vertebræ destroyed. The vertebral column is in good position. cf. Fig. 7. Shows compensatory increase of vertebræ lying under focus; corrective incurvation of spinous apophyses and atrophy of pedicles on a level with the focus.

to take place after the third, and is often only complete after five or six years, and even more.

V. *Study of the Cure*.—Fig. 9 shows a vertebra with two pedicles, an osseous block resulting in reality from the fusion of the

osseous portions remaining healthy. The consolidation is osseous, without there having been, we repeat, neo-formation. After the fibrous union, which is the first stage of cicatrization, there succeeds osseous consolidation, the last stage of repair.

The radiograph in profile shows in relief the other processes of



FIG. 9.—Pott's disease treated and cured. Two vertebræ consolidated. Shows posterior settling down and equal distribution of the osseous destruction. Shows compensatory curves and mechanism of cure; osseous consolidation without neo-formation.

cure, of which the result, from the orthopedic point of view, is to diminish or to compensate the deformities definitely acquired.

1. An atrophy and incurvation of the spinous apophyses (see Fig. 8), having the effect of diminishing the protrusion of the kyphos.

2. An atrophy of the pedicles (see Fig. 9), permitting a very efficacious posterior settling down.

3. An increase in the height of the vertebræ lying above and below the focus (see Fig. 7), compensating thus in part for the diminution in size caused by the vertebral destruction.

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CONCERNING THE TREATMENT OF SCOLIOSIS.*

BY A. SCHANZ, DRESDEN.

The debate concerning the treatment of scoliosis is the *bête noire* of the Orthopedic congresses. Wherever orthopedic surgeons are gathered together to discuss scientific questions, there is certain to be an argument about the treatment of scoliosis, and this argument is certain to end in the same typical way; some young colleague in the orthopedic practice steps forward and announces with scientific enthusiasm, that he has, by means of some new curative process, obtained successes in the treatment of scoliosis such as up to that time had never been obtained. He promises that by the correct and timely use of this means to free mankind from the scourge of scoliosis.

However great is the enthusiasm of the speaker, it is not greater than the want of it in his audience. In the ranks of the old guard, among the gentlemen who have worried themselves with the question of scoliosis, there is an expression of pitying pardon. But then—all these men have once stood on the same place from which the speaker to-day delivers his oration. They spoke on the same subject and the high horse which the present speaker rides, looks the same to a hair as that which they once so proudly rode. Is it anything to their discredit when they harbor doubts as to the capability of the gray, which is being broken in to-day, to jump better than the bay and the black which they once paraded?

Taking one thing with another the old doubters have been in the right mostly. *Every time that fresh hopes have been aroused, just so often has the disappointment followed.* It is to be wondered at, therefore, that we, who have been through a considerable number of orthopedic congresses, fear the scoliosis debate?

* Read before the International Congress in London, Aug., 1913.

In spite of this, the Orthopedic Section of the Seventeenth Medical Congress again reserved a whole session for the subject of scoliosis treatment. That has certainly not been done in the hope that the solution of the old riddle will be found to-day. *The purpose which directed this action of the Congress directors is probably to urge us on again and that with the greatest authority, to combat with the problem of scoliosis,* to an attack on that problem which has occupied orthopedic science for the longest time, that problem which has shown itself to be the most difficult to solve of all that have ever beset our science and our art.

When the directions of the Congress invited Dr. Lovett and myself to introduce to-day's discussion with our papers, and to point out the direction and aim which the discussion should take, they laid upon us an exceedingly honorable task, but also one which was fraught with many difficulties. Particularly difficult because it compels us, in comparatively small space, to treat a question and to take up a standpoint of it, when the literature concerning the question takes up a whole library. Still more difficult, however, because the danger threatens us that to-day's debate will take on the same course as its predecessors and that it will be just as fruitless as they were.

I consider the danger that straw will be threshed in our discussion to-day, which has already been threshed a hundred times, to be very great. We shall only escape this danger by giving our discussion a different beginning and setting it a different object to the one pursued up to the present.

I am not in a position to announce to you gentlemen, an up-to-the-present unknown certain remedy for scoliosis. To present this gathering with a sort of bird's-eye view of how scoliosis is treated here and there has, according to my idea, no use, for everyone of us knows it; at least he can and should be in possession of this knowledge. I also hold the critical comparison of the competing methods or the publishing of successes obtained personally to be as little to the purpose. Our discussion can, however, be very useful, if we do not bring before our own eyes and those of the world what wonderful

progress we have made in the treatment of scoliosis but only then, when we make certain of what we have not attained to up to the present. Our discussion can be of use when we investigate what can and must be regarded as attainable in the treatment of scoliosis and when we look for the reason why we have not attained the attainable. We must provide ourselves with a compass which will show us our path in the land to be explored. The great discoveries which our time has to show in all departments of medicine allow us to hope that when we have such a compass, the discoverer will find the passable way. In my paper, therefore, I set myself the object of showing what the present-day treatment of scoliosis does not perform and to investigate what may be regarded as attainable in the not attained. A further object pursued is the seeking for an explanation why our endeavors up to the present have only been able to show partial success and I should finally like to find out some bearings which would enable us to recognize the path of possible progress.

When, gentlemen, one scans the history of the treatment of scoliosis, one remarks quite a peculiar activity in experimenting. The most different propositions of treatment, the most varied experiments follow upon and run parallel to one another. They do not occur under the motto of the development of the various methods, but always as new solutions of the whole problem starting from first principles. And at the same time the various writers contradict each other in the bluntest manner. The most extreme proposals are published, proposals which leave room to doubt the sound common sense of their authors.

This sort of thing is only possible in scientific work when the sure and certain basis is wanting. Where there is a firm foundation of facts the most different intelligences will come to conclusions which will show a certain conformity. Where this common foundation is wanting, everyone's fancy is given the greatest play and it is not to be wondered at when many a man, not otherwise given to such a game, propounds the wildest theories.

That the laying down of a firm foundation, upon which a rational therapeutic treatment may be built up, has been ne-

glected, is, gentlemen, probably a statement, which, in our circles, may cause not a little astonishment and yet, it is quite easy to prove this statement to you.

The great progress which medical science has made in recent times is based upon the fact that we have broken away from the old symptomatological division of diseases and have in its place an etiological one—a division based upon the natural relations. The whole progress which natural science has made in recent times also is based upon the fact that one searches for the causes of natural phenomena. A drastic example: it was not until we had learned to group the plants according to their natural relationships and not according to Lenne's system that there has been a modern botany.

In the case of scoliosis, however, we are still in the ante-diluvian time of the symptomatological disease system.

Take for example the orthopedic text-book which has been more widely read than another such: Hoffa's *Lehrbuch der orthopädischen Chirurgie*, and you will find the following division of the deformities of the spine: sagittal anomalies in the carriage, with the subdivisions—round back, chronic spinal inflammation, rhachitic kyphosis, and saddle back. There follow: Spondylitis and spondylarthritis, tuberculous, traumatic spondylitis and then comes scoliosis with the divisions: habitual scoliosis, rhachitic scoliosis, static scoliosis, congenital scoliosis, collar bone scoliosis, scoliosis following empyema and neurogenic scoliosis—(a) the paralytic scolioses, (b) the hysterical scolioses, the traumatic scolioses, the rheumatic scolioses, the neuro-muscular scoliosis, ischias scoliotica.

The system, gentlemen, which Hoffa here presents to us is the most absolute lack of system. The nearest relations are separated by the greatest gaps, and the most foreign elements are grouped closely together.

It is almost incomprehensible that this sort of thing could occur in a modern medical text-book. It can only be explained by the fact that the decisive step away from the symptomatological observation and division of diseases, has not yet been taken. Still another thing, gentlemen, it is not there a

question perhaps of the peculiar incompleteness of Hoffa's text-book, but rather the mistake, which I could show you in such a drastic manner and which is to be generally found to-day in all the orthopedic text-books. Schulthess, who worked out the chapter on scoliosis in the Joachimsthal Handbook of Orthopedic Surgery and who certainly claims to be a modern writer in the sphere of scoliosis, expresses himself emphatically in favor of retaining the symptomatological classification of the spinal curvatures and rejects emphatically the claims of the etiological division.

Now, gentlemen, we shall probably admit without contradiction that this system of classifying the deformities of the spine is obsolete. You will probably, however, inform me that it is hardly possible that an error which could have a crippling effect on the whole science of scoliosis could be contained in it. You will perhaps emphasize the fact that for orthopedic science, which is principally engaged in the treatment of deformed bodies, a classification of the diseases according to the external symptoms, that is a symptomatological disease system is the most suitable and could hardly be dispensed with.

Certainly, gentlemen, the old garment which is the garb of orthopedic science, has been tinkered together just as the pieces best fitted and just as this costume has become in this process of manufacture we have come to get used to it and to like it. But we must throw it off if we desire to become up-to-date men in orthopedic science and especially in the therapeutics of scoliosis, if we desire to reach the summit which modern medical science has attained in other departments.

As long as we treat in our text-books, habitual scoliosis, congenital and paralytic scoliosis and ischias scoliotica in the same chapter because the spinal column shows a curvature to the side in all these deformities, so long, gentlemen, will we be unable to avoid conclusions, deduced from one or the other of these diseases and carrying them to others, conclusions which in the one place were perfectly correct, in the other, however, totally false and misleading.

Anyone who eats chocolate and cheese from the same plate

will never be quite clear in his mind as to the real taste of chocolate and cheese.

In this fact, gentlemen, that we have not yet got past the symptomatological classification to a rational system, in this fact is to be found the cause of the confusion in the field of scoliosis therapy, and that is the heaviest fetter which has hindered the advance of the progress of scoliosis therapeutics. Therefore, if we desire to carry on a useful discussion, it is absolutely necessary to effect a clearance first in this place.

We must begin by fixing the term scoliosis.

Here we will not speak of all diseases which show a lateral curvature of the spine. When the direction of our congress set the subject of the treatment of scoliosis they did not intend that the therapeutics of all those diseases should be discussed in the symptomatology of which a lateral curvature of the spine is given, just as little as we orthopedic surgeons, when speaking loosely of scoliosis think of the whole collection which Hoffa, for example, gives us under this definition.

In practice, gentlemen, we have set up a definite conception of scoliosis, let us carry this out in theory also and seek to find a sharp scientific definition.

What do we orthopedic surgeons understand by scoliosis.

Diseases in which alterations in the skeletal structure occur are named by us orthopedic surgeons "scolioses."

Now what is characteristic about these skeletal alterations? Infinitely much. It will suffice, however, to take a few pregnant examples. I will choose such as are particularly conspicuous and which are especially peculiar and I shall only put so many together that a symptom-complex occurs which will suffice for a definition of the concept.

The first thing which one notices in all three skeletons is, that the spinal column is laterally curved out of shape.

This curvature, however, is not a simple one. Instead we have besides the great curvature, which we utilize for giving the designation, *e.g.*, right convex dorsal scoliosis, also two slighter curvatures in the opposite direction, the upper and the lower countercurvatures.

If we regard the single vertebræ we find these also regularly repeated, conspicuous divergences from the normal form. I will not describe and will not show diagrams of these alterations as you know them as well as I do. I will only name them. We find then in the spinal column of our third diagram in a definite place wedge-shaped vertebræ, oblique vertebræ, and vertebræ between these two types.

As a further regular and exceedingly characteristic part symptom of our scoliosis skeleton we see the torsion which expresses itself in the spinal column as a whole, in the wedge-shaped and oblique vertebræ and in the ribs with the unconditional regularity of a law.

Enough of that! The part symptoms named here we find in every case of real scoliosis. They are so peculiar and characteristic in their construction that they suffice for the definition of the conception scoliosis.

All real scolioses, gentlemen, show these symptom-complexes; lateral curvature of the spine with formation of principal and countercurvatures, with cultivation of wedge-shaped and oblique vertebræ and torsion. And if we turn this sentence round, then we have the means of settling whether a lateral curvature of the spine is to be spoken of as a real scoliosis: A deformity where we have a complex of various curvatures of the spine in various directions, where we have the cultivation of wedge-shaped and oblique vertebræ and vertebræ between these two, and where we find the characteristic symptom of torsion, that, gentlemen, is a real scoliosis. Where these recognition marks are not present, where only one is missing, there we have not a real scoliosis, even if one case otherwise is as like another as two eggs.

If we now cast a glance over the deformities which are commonly known under the name scoliosis and see which among them we can admit as real scolioses and those which we must reject from the scoliosis chapter.

If we now keep to Hoffa's text-book, we shall recognize the habitual and the rhachitic. We may also add a number of scolioses which are not mentioned in Hoffa's book, *e.g.*, if it is

to be separated from the habitual, then the constitutional scoliosis, then the osteomalacic and the osteopsathyrotic. I have shown preparations of the last two at the fourth Congress der Deutschen Gesellschaft für orthopädische Chirurgie and demonstrated the characteristic forms of the real scoliosis on the same. Also the stone carrier's scoliosis described by Golobiewski and the apprentice's scoliosis described by myself are real scolioses.

We cannot, however, recognize the congenital as a real scoliosis. However similar in its exterior form it may be to those, yet the congenital deformities on which the congenital scoliosis is based do not belong here to our symptoms.

Collar-bone scolioses are just as little to be considered real scolioses; they are very nearly related to the congenital.

The cicatricial, that following empyema, the hysterical, the rheumatic, the scoliosis ischiadica you will allow me without discussion. Also the traumatic scoliosis of Hoffa you will permit me to discard.

There now remain only the static and the paralytic scolioses. Now comes a difficulty. We know static and the paralytic scolioses as fixed and unfixed form. In the case of the unfixed form we have no wedge-shaped and oblique vertebræ and no torsion. In the case of the fixed form these are all present, and also curvatures and countercurvatures.

Here when carrying out our classification, we should have to recognize the fixed static and the fixed paralytic scolioses as real scolioses but we should have to reject the unfixed forms. Would that not be an unnatural separation of disease complexes which should go together? Would my natural system not by this means be reduced to absurdity?

Allow me, gentlemen, to postpone the answer to this question. I will answer you as soon as I have presented my opinions as to the origin of the real scoliosis.

We must also have a definite picture before us as to the origin of scoliosis if we are to follow a consistent system of therapeutics and we must come to an agreement about this picture before we can begin with the discussion of therapeutics. To quote a

few examples, when one attributes the origin of scoliosis to a disturbance of the equilibrium of the tone of the back muscles, another to a disturbance in the development of the embryo, a third in a statical overweighting, a discussion of therapeutics is, in the nature of things, quite impossible. Each of the three would on principle make different proposals and would endeavor to explain the results by his own opinions in this way or that.

For this reason, gentlemen, we do not dispense with the necessity of engaging ourselves with the etiology of scoliosis, with this we come to a chapter to which an enormous quantity of ink and paper have been sacrificed, without any unanimity having been arrived at. At the same time this question is comparatively easy to answer and with a certainty which is exceptionally rare in medical questions. We can solve the question after the etiology of scolioses with the help of mathematical, or more correctly physical calculation and that on this basis:

As long as there has been an investigation of scoliosis, those engaged in the research after the cause of the deformity have continually had the impression forced upon them that the weighting of the spinal column must play some part in the etiology of scoliosis.

Scoliosis has been classed under the weighting deformities as long as the conception of a weight deformity has existed. Only we have not yet quite found out how the weighting has a deforming effect and what factors of the weight which otherwise is borne without injury by the spinal column give this power to deform.

Here we can come in with physical calculations, by reckoning out under what conditions and to what forms are columns deformed by weighting when they stand under the same conditions as the spinal column in the human body. If these calculations give us pictures which correspond to the characteristic form alterations in the case of the formation of scoliosis, we can, indeed we must, take it that these alterations in the form of the spinal column have arisen according to the same general laws, upon which we have based our theoretical calculations, that

these alterations are nothing else than the expression of the work of physical forces.

I will not lay these calculations before you to-day, gentlemen. They were carried out by me and published in the literature. I direct special attention to my monograph: "Die statischen Deformitäten der Wirbelsäule mit besonderer Berücksichtigung der kindlichen Skoliose," which appeared in Stuttgart in 1904, published by Enke, as well as to the paper by me at the fourth Congress der Deutschen Gesellschaft für orthopädische Chirurgie and entitled "The Mechanics of Scoliosis." When working out my present paper I have gone through the figures given in the papers mentioned and find that I can maintain them in every particular.

In referring shortly to those works, I must content myself with giving the premises upon which I based my calculations and the results to which they led.

One of the most important functions of the spinal column is the task of supporting the weight of the head, the trunk, the upper extremities and accidental burdens. A corresponding strength is given to the spinal column for the fulfilling of this function: its bearing power or static strength.

The spinal column fulfils its task of weight carrying without any injuries as long as bearing power and load are normal, or more cautiously expressed, as long as the load and the bearing power are in correspondence as to their quantity; as long as the weight equilibrium on the spinal column exists. If this weight equilibrium is disturbed, then injuries to the spinal column must occur, just as any other organ in our body suffers injuries when specific functions are demanded from it to a greater degree than its ability to perform them; the overstrained eye becomes short-sighted, the overstrained ear becomes a little deaf, the overstrained heart becomes insufficient, etc.

When the spinal column falls under the influence of a burden which is too great for it, injuries must arise and they are of the same kind as hold good for the overweighted bearing column generally. The relations between the spinal column and its load are naturally subject to exactly the same laws as those

between any other column and the weight resting upon it. Whether a column stands in the living human body, or in a house, or in the construction of a bridge, the relations in every case are governed by the same primary laws. Every such column becomes injured on being overloaded and these injuries are the same with the uniformity of natural laws. They only show variations caused by the particular properties of the different pillars, *e.g.*, greater or less flexibility, elasticity, breaking resistance of the material of the column.

The circumstance that the human spinal column forms part of a living organism does not abolish for it the general laws of the loaded column. We can only condition a difference as against column of so-called dead material in the fact that the living organism is capable of accompanying the sequence of the processes which result from the overloading of the spine according to physical laws, with signs of life—with reaction symptoms. We may expect with the greatest probability that such reactionary symptoms really do occur, because the living organism replies to all influences which are injuries and dangerous to it with reactionary symptoms.

We must, therefore, have two kinds of alterations if scoliosis is a result of misproportion in the loading; first such as are conditioned by the accommodation of the bearing power and the load, and secondly those which accompany this play as the reactionary symptoms of the living organism. This admission is an exceedingly important determination of the pathological state. The two groups are distinguished by the fact that we can calculate the symptoms of the first group according to the laws for overloaded columns while in the case of the second group this is impossible.

Of the results to which one comes finally in the carrying out of this calculation, I should like to quote a few particularly important ones and I select such as are in connection with the symptom-complex which I gave as being characteristic for the real scoliosis.

The occurrence of a combination of principal and counter-curvatures is conditioned by our spinal column being, with its

end sections, confined to the plane of the floor and the plane of sight; a loaded column with its end sections bound to horizontal planes, in the case of overloading, bends with the production of a principal and two countercurves.

The torsion is explained by the fact that the spinal column is composed of a series of bodies and of curves. The series of curves rests on the series of bodies just like a reinforcement band on the periphery of a column. In a column so reinforced the overloading first comes on the point on the periphery opposite to where the reinforcing band is, and lastly where the band is attached. The bending due to overloading is, therefore, felt at different times at different points of the cross-section of the column. Consequently arise its twisting motions, which we, in the case on the scoliotic spinal column, describe as torsion.

Wedge-shaped, oblique, and intermediate vertebræ are also formations conditioned by mechanical laws. If we cut a bent column into pieces corresponding to the vertebræ we find the typical signs in these of those vertebral alterations.

Why, gentlemen, have I mentioned to you these calculations and quoted to you their results?

Because these calculations must remove every doubt as to the cause of the origin of scoliosis. Where the results of calculations and observations on the single object so agree as they do here, there can be no objections and doubts that this object is an example of the application of natural laws. With those who do not agree to this it is as impossible to discuss the question as it is to discuss the correctness of a mathematical calculation with one who does not recognize the axioms of mathematics.

Now, gentlemen, you must allow me to take a few examples from the group of reactionary symptoms of the living organism. They are important for many questions of therapeutics.

Analogous with other diseases we may expect that, in the case of the occurrence of any overloading conditions in the spinal column, the living organism will draw the attention of the patient to the fact that there is something wrong with the machinery of the body.

We may further expect the body endeavors to defend itself against the injuries and to repair the damage already done.

To the first group, to the signs with which the organism draws the attention of the patient to the danger, to the signal symptoms belong the pains in the back, which are mentioned in our text-books for the early periods of scoliosis and the intercostal neuralgia of the old severe scoliosis. Here also are to be included all the symptoms which I have gathered together under the title of *insufficiencia vertebræ*.*

Thus the sensibility to blows in the line of the spinal processes, the sensibility to pressure in the bodies of the lumbar vertebræ, the sensibility to pressure of the intercostal nerves, the sensibility to blows of the sternum, etc.

The importance of these evidences of insufficiency for prognosis, indications for treatment and therapeutics make it necessary to draw attention to them here.

I will not go into the group of defensive activities which the body is capable of developing against the formation of scoliosis. I will only mention they exist and have been described in my above-mentioned works.

Corrective appearances are unknown up to the present. They must, however, sometimes occur as otherwise the spontaneous correction of scoliosis which in the lighter cases is sometimes doubtless to be observed could not happen.

At this point I should like to cast a short look back. The ground upon which the building of therapeutics is to be erected has been laid with what I have already said.

I recapitulate: The real scoliosis is a deformity of the spinal column arising in the postfetal life.

Its characteristic symptoms on the spinal column are: in the first place the formation of a complex of principal and countercurvatures, second, the formation of wedge-shaped, oblique, and intermediate vertebræ and third, torsion.

Scoliosis arises on account of a disturbance of the weight

* A. Schanz, Ein Typus von Schmerzen an der Wirbelsäule. Verhandl. der Deutschen Ges. f. orthop. Chir., 1907. *Insufficiencia Vertebræ und Scoliose*, Berlin klin. Wochenschr., 1908, No. 43.

equilibrium on the spinal column, the characteristic of which is, that the static demands exceed the static ability.

The pathological appearances which arise on the formation of scoliosis form two vitally differing groups: first, the appearances resulting from the play of mechanical forces, second, the group of reactionary appearances with which the living organism accompanies the disturbance on the spinal column.

We will treat one more question, gentlemen, before we go on to speak of the treatment of scoliosis and that is the practical significance of scoliosis.

I have just mentioned to you quite a number of real scoliosis forms: the habitual, the rhachitic, the osteomalacic, the osteopsatyrotic, stone carrier's and apprentice's scoliosis and this list may, as I have already said, be considerably lengthened.

Of all these forms of scoliosis, those arising in youth are by far the most important practically as compared with all the others, so much so indeed that we in practice by scoliosis understand loosely only the youthful forms: that is the rhachitic, the so-called habitual with its subform, the constitutional and the form which I have described as apprentice's scoliosis.

These forms which show a certain uniformity and which we can class together under the general term youthful scoliosis are the ones which take up the greater part of our attention in the practice and which again should be described among the real scolioses by our present subject of discussion.

Where it is not emphatically otherwise stated when I speak of scoliosis I have in my mind this youthful scoliosis.

The practical importance of the single forms induces me, however, to undertake a further important classification of the group of youthful scoliosis.

A serious scoliosis is a great injury to the person afflicted with it. The deforming of the body, the injury of the whole organism, the limitation of the power of work, and to enjoy as compared with the pleasures of life all of which are accompaniments of a serious scoliosis make it a very, very, heavy burden. The wide distribution of scoliosis gives it, however, also a great social importance. The strength of a people will

be severely handicapped if a large number of its natives are afflicted with scoliosis.

To draw attention to the imperilling of the single person, to the imperilling of the nation by scoliosis is the first duty that we orthopedists have to fulfil in the combat against scoliosis.

However, one thing I should like to point out with all emphasis and that is, in pointing out the dangerous nature of scoliosis we must at all costs avoid any exaggeration.

In Germany and also in many other countries the school children have been examined for cases of scoliosis and very high figures were found up to 80 per cent. scoliotic children. From this one came to the conclusion that the strength of our nation was severely endangered by scoliosis.

The conclusion, gentlemen, was an enormous exaggeration. I have proved that from our recruiting statistics. The kingdom of Saxony in which I exercise my activities is, according to the cripple statistics, that part of Germany which has the most cases of scoliosis. In spite of this at the time of recruiting only $1\frac{1}{2}$ per cent. were rejected on account of scoliosis and here where Germany has such a great surplus of recruiting material a very, very sharp lookout is kept for scoliosis. If we have 80 per cent. scoliosis school children, there can only be a very small percentage of these, putting it at a very high figure, say 2 per cent. to 3 per cent., which could be of any importance. In spite of this, of course, scoliosis remains a very serious disease and the health of our people is heavily enough handicapped by it.

We orthopedists, however, must learn one thing from these figures and for this reason I have quoted them and that is, not every young person by any means who suffers from scoliosis runs a serious danger.

Among the youthful scolioses we have such which never become of serious importance and at most attain the dignity of a blemish to the beauty of the body, and which generally disappear without any treatment when the youthful body ripens into adolescence.

I should like to name these light scolioses in distinction to the

malignant ones, which grow in rapid strides until they become great deformities and injure the whole personality for the whole life in the most serious manner. These malignant forms—I should like to emphasize this, in order to correct a widespread error—do not come to a standstill approximately with the end of growth of the body, but become through the whole life increasingly worse.

The proportion between the mild and the malignant scolioses is really favorable as I have already hinted above. In my practice where it is, of course, different to the school and recruiting statistics, I find, for ten mild scolioses only one malignant one.

If, gentlemen, it is our first duty to draw attention to the danger of this disease for the single patient and for the nation, then it is our second duty to point out the differing importance of the mild and the malignant forms.

In the cases of ten children brought into our consulting room on account of scoliosis, it is a pleasure for us and a relief for the parents of the patients that we can say that the child will never suffer any serious harm from the scoliosis and that fears have been entertained which were groundless. Not until then does one come where the answer must be quite different.

It would be a great pleasure for me to go into details how to distinguish the mild from the malignant form of scoliosis. I should then come to a question which has by no means been generally cleared up. It belongs, however, to the chapter on the diagnosis and I must, therefore, deny myself its treatment here.

But I must not pass over the question of the necessity of medical treatment, the question: Do the scolioses require medical treatment and under what conditions and to what degree do they demand it?

The question is at first very easy to answer for the malignant form. Such severe diseases cry out for medical help. This must be offered as soon as possible and as effectively as possible. Even when the success of the treatment compared with the expenses of all kinds which we are compelled to incur does not appear to be satisfactory. Then even the slight success at

first becomes a profit for the patient by enabling him to make use of his future.

It is quite different in the case of the mild scoliosis which at its worst is only a blemish, easily corrected by a clever tailoress. It comes to a standstill with the complete development of the body and in a great percentage of cases spontaneously heals completely. As we see, a quite different picture to that presented by the malignant form of scoliosis.

The medical duty as regards the mild form is fulfilled when we have diagnosed it as the mild form when we have confirmed our diagnosis by observation and when we take care that our patient does not do things which might transform the mild into a malignant scoliosis.

I cannot recognize a necessity for treatment in the case of the mild form. It is our sacred duty as honorable medical men to be quite clear about the fact that when we take the mild form into treatment that we are playing with work, and that we are making *luxus cures*. It is our sacred duty to inform our patient of this with all possible clearness and it is also quite as serious a duty to consider in every case whether the sacrifices which the cure requires correspond to the possible advantages to be derived from it. From a well-to-do family which under no circumstances will have a blemish on the child we may take the child with the slightest indication of a mild scoliosis into treatment, we may, if there is no other way, order a great, expensive cure. It is quite a different question, however, with a family of smaller means. We must never prescribe a cure in the case of mild scoliosis, which would cause any expenses worthy of the name.

These same considerations should hold good when it is a question of using public or charitable funds. In the care of cripples, at least in the field of my activities, is seen most clearly the necessity of providing possibilities for the treatment of the malignant scoliosis. Just as energetically as I demand that great funds should be placed at our disposal for this on the side of the state, public bodies, and public charities, just so emphatically do I agitate against the wasting of such moneys, the work

of voluntary helpers and the time of assistants, in the treatment of mild scoliosis.

After answering the question, under what circumstances we are to treat it, comes the question: how we are to treat scoliosis.

In all therapeutics, *prophylaxis* is the first task, and this is also the case with scoliosis. Here also we cannot pass over the prophylaxis of scoliosis.

A condition for every prophylaxis is an exact knowledge of the etiology. We cannot prevent a disease if we do not know its cause.

In searching for the etiology of scoliosis we have arrived at the conclusion that the cause of the formation of scoliosis is a disturbance in the weight equilibrium of the spinal column. For the prophylaxis comes the conclusion that we have to prevent the occurrence of such disturbances, that is a conclusion very easy to make, very simple and also quite right.

It has only one thing wrong with it and that is it does not work out in practice. If we wish to prevent the disturbances of the weight equilibrium of the spinal column, we must first go into the question how can and do such disturbances arise.

In the researches in the etiology of scoliosis we must, therefore, go a step further.

The disturbance in the weight equilibrium of a weight-carrying column may be conditioned in two ways by a diminution of the carrying capacity of the column on or from the side of the burden, by an increase in its weight. Both possibilities can, of course, occur together.

If we seek for moments, at which the static loading of the spinal column can be increased and its carrying capacity diminished, we can place in the second group straightway those diseases a specific property it is to soften the bones. There is absolutely no doubt that a rhachitic as well as an osteomalacic spinal column possesses a diminished carrying capacity. Also in the case of the so-called constitutional scolioses the carrying capacity of the spinal column is reduced without doubt. I only remind you that these bones give pictures which are not

to be distinguished from those of real rhachitis (Rupprecht, Schmorl and others). The science of late rhachitis rests principally on these pictures.

Further, the bearing capacity of the spinal column varies very considerably without its being up to the present possible to recognize this from the anatomical state. Even anatomically quite healthy spinal columns behave differently as regards their bearing capacity.

When the vertebral bones are introduced into a crushing machine such as is used by technical men for testing building and other materials as to their resistance to pressure one obtains very interesting results.

There are found on vertebræ, in which we cannot find any anatomical difference, extraordinary differences in the bearing power, the resistance to breaking, the ability to be compressed and the power of returning to the old form after the load has been taken off. After carrying out a considerable number of examinations and regarding the results, one sees that in the thousand variations there are, however, various distinct types. *E.g.*, for healthy vertebræ of different ages pressure curves may be drawn and it can be ascertained that vertebræ which deviate considerably from the normal pressure curve are in some way pathologically changed. Such disturbances are seen in rhachitic vertebræ. They may be seen in vertebræ which have been visited by a trauma, without any traces of the trauma being able to be anatomically proved. Further disturbances are seen in the cases of vertebræ which come from persons who have died of general wasting diseases, also in periods of particularly rapid growth and in the period of development during puberty such pictures appear to occur very frequently.

The disturbance in all these cases is of such a kind that that vertebra can be more easily deformed under the influence of pressure than under normal conditions.

The results of these investigations which I have had made and concerning which to furnish detailed information tally with the old results of practical observation: under all the circumstances

under which we observe the development of severe scoliosis we find abnormal pressure curves in the crushing machine.

We find in this way the explanation why a scoliosis is formed on a spinal column which shows rickets or rhachitic diseases. One understands why, following trauma, a scoliosis can occur, how scoliosis appears after measles, scarlet fever, whooping-cough, how scoliotic curvatures appear in the time of particularly rapid growth or during puberty, how scoliosis can set in in the case of women after rapidly following pregnancies or how old scolioses can be made worse.

This will suffice for examples of the diminution of the carrying capacity.

How is it now with the increase of the load?

The conception of load consists of two components of the greatness of the weight imposed and of the duration of the burden. A light load which is imposed for a correspondingly longer time gives the same load effect as a heavier one which only is carried a correspondingly shorter time. An overloading may, therefore, occur by the imposition of too heavy weights, but may also be caused by a weight not too heavy if it must be carried an abnormally long time.

If we seek for examples of both, there is the classic example of the stone carrier's scoliosis. In Berlin it is usual to have the bricks carried up into the building by workmen. These workmen are extraordinarily strong men, with figures of athletes, whose vertebræ certainly possess normal carrying capacity. As a sickness peculiar to their profession there is found among these hod-carriers the scoliosis described by Golobiewski. There can be no doubt that it is caused by overloading.

Examples of the injurious effect of a load carried an abnormally long time are easier to find. I can quote the apprentice's scoliosis described by myself.

I often see among the working classes of our people young persons of both sexes from fifteen to twenty years of age who have contracted scoliosis after having left school and taken up some profession which entails long periods of standing or walking or much sitting. The scoliosis which one sees in these patients

develops generally very quickly to a very high degree and they generally go about with severe symptoms of insufficiency.

The disproportion in the loading conditions is, in this case, caused by the spinal column which up to then had done its work, being called upon to carry the not abnormal weight of the body for a more than normal time.

In this connection I should like to add a few remarks on the importance of the school in the formation of scoliosis.

Formerly we looked for a very first cause of the scoliosis formation in the school. Hoffa would consider nothing else. If anyone uttered his doubts to him he did not consider a reply necessary.

I myself as a pupil of Hoffa have also lived with the idea that the school was an important etiological moment for the formation of scoliosis and believed to find the explanation in the fact that the long duration of the sitting in the school was accompanied by an abnormally long loading of the spinal column and that in this way the disproportion of the loading conditions and the scoliosis were brought about. Here I had made a serious miscalculation. The scholar sitting in his desk supports himself on his elbows and leans against the back of the desk. In this way he removes a part of the load from the spinal column. The injuriousness of the abnormal duration of the sedentary work may thus be completely balanced.

That we find among our youth an increase in scoliosis during the school years can be explained without the school necessarily being the cause. During the school time occurs the greater part of the bodily growth, in the school time occur the greater number of the children's sicknesses, during the school time almost without exception the puberty development takes place.

Those are important factors for the formation of scoliosis which completely explain the increase of scoliosis which occurs in this time.

Not only that, I am fully convinced that the school offers our youth a certain protection against scoliosis, simply because

the children load their spinal columns during a great part of the day only comparatively little.

In order to prove this to you, gentlemen, I remind you of the investigations which Kirsch undertook in the case of the Magdeburg school children. Kirsch examined the children who came to school. Among them he found a small percentage (about 2 per cent.) scoliotic. These scolioses showed themselves to be the severe malignant forms. During the school time the number of scolioses rose to 20 per cent. and 30 per cent. On investigation, however, it appeared that the number of malignant scolioses had not increased. What had appeared during the school time in addition to the 2 per cent. which came to school, were light mild scolioses.

If you place my observations on apprentice's scoliosis, that is, the fact that young people who leave school free from scoliosis by no means seldom contract scoliosis and in quite a large number of cases very severely, together with these investigations, then, gentlemen, the opinion that the school does not represent a scoliosis forming peril but rather a protection against scoliosis will not appear to you to be so absurd.

Before I can go on, from these remarks about the etiology of the maldistribution of the loading which sets the formation of scoliosis in action, to come to any conclusions for the prophylaxis, I will go into a question which I previously put but have not yet answered. In the separation of the real and unreal scolioses I came to a halt before the static and before the paralytic scoliosis. I said that both in the static and in the paralytic we are acquainted with two stages: the nonfixed and the fixed. In the nonfixed we have the lateral curvature but no deformation of the bones, no formation of wedge-shaped vertebræ and no torsion. In the fixed stage we have changes in the bones characteristic of real scoliosis. How does our classification of scoliosis get over this difficulty?

Now, the explanation does not cause any difficulties. First we must ascertain that every static and every paralytic scoliosis may remain an indefinite time in the nonfixed stage. That the change to the fixed stage may take place at any time but is

never a necessary result. Besides, these scolioses in a non-fixed stage are nothing more than quite unimportant symptoms of a disease. The importance of an independent clinical picture which we shall always allow to scoliosis is never allowed to these nonfixed static and paralytic scolioses. I only beg to remind you, gentlemen, that the nonfixed static scoliosis disappears at once as soon as the patient sits.

Again there is, however, no doubt that such static and paralytic scolioses can become fixed and that they then take on the characteristic forms of real scoliosis, indeed now and then they follow the path of the real malignant scoliosis.

The solution of this difference is as follows: If a spinal column is compelled, as a result of a difference in the length of the legs or through any other cause, to take up an oblique position for considerable lengths of time and to carry a burden while in this position, it comes by this means under less favorable static conditions than when such is not the case. Every column has a greater carrying power when it is perpendicular than when it is brought into an oblique position, and a load placed centrally on a pillar makes a slighter claim on the column than when it is placed upon it eccentrically. In the cases of the nonfixed and paralytic scoliosis we have in the first place a bringing of the spinal column into an oblique position and second, we have an eccentric loading as a result of the shifting of the center of gravity of the body. We obtain in these cases, therefore, first a reduction of the carrying power and second, an increase in the load to be borne.

It is now a question as to whether the spinal column possesses a reserve of power and whether this is large enough. If this reserve is great enough for the increased demands then a disturbance of the equilibrium of the load does not come about. These static and paralytic scolioses remain unfixed: they remain a symptom. If there is no reserve of strength at hand or if it is not sufficient, then a disturbance of the loading equilibrium arises and it goes on until we have the formation of a real scoliosis: the static, the paralytic becomes fixed. The scoliosis thus induced will naturally follow the path previously sketched out

by the static or the paralytic scoliosis for it. It will imitate their form and will reach the degree conditioned by the degree of the abnormal loading conditions.

Now, gentlemen, let us come down to practice again and that with the question: how can we prevent scoliosis?

What may be generalized from our remarks for the prophylaxis of scoliosis?

We have come to the opinion that the malignant forms of the youthful scoliosis have their cause in a process of bone softening through rickets or rhachitic diseases, and that (apprentice's scoliosis) professional overwork may also produce severe scoliosis in the case of young persons. We have further come to the opinion that the mild forms in their causes are connected with rapid growth, with exhausting children's diseases and with puberty. These two lists would naturally have to be lengthened, but I make no claim to completeness.

If we look over this list to see what dangers we can remove from the way of our youth, we shall hardly be very pleased.

Rickets may be combated and one of the most important tasks of the care of the cripples will be the struggle against rickets. It will, of course, have a prophylactic effect in connection with the rhachitic scoliosis. In this way we should, according to my opinion, not greatly reduce the quantity of malignant scolioses. Even if the pathological anatomists show us ever so beautifully in microscopic preparations that the alterations by which he diagnoses the microscopic diagram of rickets, the alterations in the vertebræ of the so-called constitutional scoliosis, are to be recognized to the very smallest detail, still the forms and the course of the real rhachitic scoliosis differ so clearly from those of the constitutional that I cannot convince myself of the identity of the diseases of the bones which are certainly present in both cases. I am convinced there is here a weak point in pathological diagnostics.

The disease which, in the case of the constitutional scoliosis, diminishes the carrying power of the spinal column, we do not yet know.

We are therefore to-day not yet in a position to take any

preventive measures against this the most important form of scoliosis.

We are in a more favorable position with regard to the apprentice's scoliosis. Here it would be sufficient if the school doctors examined the children before they left school and warned such as were not strong from taking up professions which demanded great bodily efforts. Besides this the medical profession must be made aware of the danger of scoliosis with youthful workers so that those falling ill with it may be withdrawn from their dangerous work in time.

When we come to regard the prophylaxis of the mild scoliosis we shall there also have to be satisfied with the prospect of half successes.

When a child shoots up particularly fast, when he falls ill with wasting diseases, and when he suffers particularly from puberty what can we do against that? We shall have to be contented with bringing those entrusted to our care through this period as well as possible. We shall guard them against overstrains, above all from overstraining the carrying capacity of the spinal column as much as we can. We shall endeavor to raise the level of their general state of health and to keep it at a high standard. We shall pay particular attention to the strengthening of their bone system, for example, by proper feeding, we shall try to strengthen the spinal column and its muscular system by means of sport, massage, and the like. But in all this there is no certain prophylactic present.

Still less is this the case with all the other things which hitherto have been recommended for this purpose. I will mention a few of them.

The school bench has been the cause of the greatest amount of writing as scoliosis-prophylactic. Certainly we should make the sitting in school for our children as easy as possible in view of scoliosis and in the choice of a school bench this should be the first consideration. But that, by the introduction of this or that bench, we could make a school free of scoliosis is a thing which we cannot for the world imagine.

It is just the same with the upright writing, which was once

recommended as a preventive against scoliosis and has been widely introduced. It is the same with gymnastics in general and with the various systems of gymnastics in particular, the same with the reform of the girls' clothing and the same with the prohibition of corsets for the girl scholars.

All these things are very fine and good but they will not abolish scoliosis from our youth at school simply because they do not go to the cause of the formation of scoliosis.

When I say this here I do not do so from theoretical considerations, not because of an opinion which I have formed for myself; I simply repeat an experimental fact. Go, gentlemen, into those schools where those preventive measures have been introduced against scoliosis and you will find there quite as much scoliosis as in those schools which have done nothing against it.

Why do I quote this here, gentlemen? So that we, in future, shall not make such propositions! The unavoidable non-success discredits us.

The hope that we can stop up the source from which the scoliosis comes, and that it will only be a question of time when humanity will die free from scoliosis, we must for the present give up as unattainable and we shall have to continue to combat scoliosis, gentlemen, although the struggle has not yet shown successes which could stimulate us to further efforts.

A rational system of therapeutics can only be built up by ascertaining the demands which therapeutics have to fulfil, from the pathology; or in other words, we only come to a rational therapeutic system by deriving the indications from the pathology, and without any consideration whether these indications can be fulfilled or not. If these indications are obtained then we must keep beside them the therapeutic means available. We shall see from the summary what therapeutic means can come into question at all and we shall be able to estimate and try to what extent the indications set can be fulfilled by means of the therapeutic aids at our disposal.

If it is not possible to satisfy them, we obtain in this way at least a definite boundary to our therapeutic abilities and we

shall be led to the point from where we can attempt to increase the scope of our therapeutics.

This is also to be the plan of my further remarks.

First: How do we obtain the indications for the treatment of scoliosis from pathology and what are these?

I have endeavored to prove that all real scolioses come from the same uniform cause: form a disturbance of the distribution of the static load on the spinal column. Further I have endeavored to prove that all real scolioses are characterized by definite anatomical changes of the spinal column or the torso-skeleton. Consequently, we should have to distinguish in the pathology of scoliosis, between the disease process of the formation of scoliosis and the result of this process: the scoliotic deformity. These are two pathological concepts which we have to keep perfectly clear from one another, not only when setting up the indications, but which we must also keep in mind in the case of every single measure which we take when treating a case of scoliosis.

The deforming process sets us the task of restoring the disturbed loading equilibrium of the spinal column; the deformity caused by the deforming process sets us the task of restoring again the normal skeletal form.

These are two tasks which lie in quite different directions.

We can expect from the outset that a remedy suitable for the solving of the one will not always by any means be suitable for solving the other. Indeed, it should not be at all surprising to us to find that a remedy which does good work in solving the one, has a direct negative effect in the case of the other. And then we have the further complication that both these so vitally differing tasks are set us at the same time in nearly every case of scoliosis which comes to us for treatment. In scoliosis the deforming process does not end at the moment when it has produced the deformity, but the deformity goes on increasing. It is almost never that we obtain a case where we can say, "Here the deforming process has come to an absolute standstill and the danger that it will become active again or

that it will be started again by some treatment which aims at the correction of the deformity, is abolished."

In addition, the two indications are to be met with on the single object in the most varied combinations imaginable.

If we have a very early scoliosis, there is practically no deformity present. The indications of the deforming process prevail absolutely. If we succeed in healing it the trace of deformity which it produced is no longer of any importance.

With an advanced deformity it is different, where not only is a deformity immediately visible but also where the breast and abdominal organs are so severely dislocated and compressed that serious disturbances to the health result.

In these cases the indication to correct the deformity occurs with quite a different emphasis. When we succeed in bringing the deforming process to a standstill, we cannot yet by a long way speak of a satisfactory result. The deformity which still remains retains its injurious effects upon the figure, the vital forces and the life happiness of the patient. For this reason it requires correction.

Between these two extremes all possible combinations come into our hands daily.

Correctly to recognize the combination of indications of coming and complete deformity, in the single case, and to induce the correct method of treatment from them is one of the most important and most responsible but also at the same time one of the most interesting tasks of the whole scoliosis therapeutics.

When this situation becomes clear to anyone, he must straightway come to the conclusion that there never can be a uniform scheme for the treatment of scoliosis but that it demands a very sharp individualization.

If we regard the two indications singly, the deforming process, as already mentioned, when it is produced by a disturbance of the loading equilibrium, requires a restoration of the loading equilibrium.

This is quite a similar demand to that which the prophylactics of scoliosis placed upon us.

There we had to prevent the occurrence of the disturbance, here we have to remove the disturbance of the loading equilibrium.

The means which would have to be used in the two cases would be approximately the same. Here as well as there we should look for the cause of the disturbance and see how we could put it out of action.

Let us take the example again which we placed in the forefront when discussing prophylaxis, namely, rhachitic scoliosis, and we may expect that the spinal column will regain its normal carrying power on the curing of the rickets and that from this moment the loading equilibrium will be regained and the scoliosis will be brought to a standstill.

As a matter of fact the real rhachitic scolioses offer a very favorable prognosis in this respect. If we cure the rickets, then the scoliosis also comes to a standstill. And if we have known how to make the best use of the time from the beginning of the treatment up to this moment, the time in which there exists an increased plasticity of the spinal column and of the torso-skeleton, for the corrective measures, we can not only bring the rhachitic scoliosis to a standstill but also obtain excellent corrective results.

The real rhachitic scolioses, when taken in hand in time, are probably the easiest to influence therapeutically.

In this respect there is a great difference between them and the constitutional scolioses. Even when these, as I have already remarked, look exactly the same in the microscopic bone preparations as the rhachitic; yet the antirhachitic general treatment which attains such a complete success with those breaks down here completely. We do not possess a specific means in these cases of restoring the diminished carrying power of the spinal column to its normal condition.

When we come to the mild scolioses, where we must suppose slight disturbances of the carrying power of the spinal column, we have also there no specific means of healing. In the case of a softness due to rapid growth, weakening of the resistance of the bones by a wasting general disease, or by puberty, we

can only improve the carrying power of the vertebræ by a raising of the general health all round, by an improvement of the constitution. Indirect and slow to reach its goal as this method may be, yet it is important to adopt it in the case of the mild scolioses. In this point correct prescriptions are altogether the most important in the treatment of these cases. Very often we can and must limit ourselves to such prescriptions. And besides this, the other therapeutical measures will only attain their possible success when the right thing has been prescribed and carried out here.

What it is necessary to prescribe for such a constitutional improvement I will not go into. It is there a question of things which are not specific to the scoliosis therapeutics but of measures which are the general property of therapeutics.

The investigation of the means of treatment coming into question for the deforming processes here shows a deficit. We cannot balance every factor which occurs as disturber of the loading equilibrium by a counterpoise, or, to use the ordinary medical terms there are quite a number of disturbances of the youthful body which reduce the carrying capacity of the spinal column without our being able to oppose a specific remedy to each such disturbance.

That is a regrettable fact but all the same we are not at the end of our therapeutic remedies. Where there are no specific remedies we can often help the patient very much with symptomatic or palliative treatment. Here also. If we cannot restore the disturbed loading equilibrium by destroying the cause of the disturbance, we can attempt to attain the same end by the insertion of some means which robs this disturbing cause of its disturbing effect.

Let us take for example a pair of scales in which the beam is brought into an oblique position by a weight placed upon one of the scale pans, the horizontal position may be restored by taking away the weight—that is etiological therapeutics, or one may restore the horizontal position by placing an equal weight upon the second scale pan—that would be the equivalent of symptomatic or palliative therapeutics.

It should not be objected that palliative remedies finally lose their effect, because, in any case they can only be used for a limited time. In the case of the scoliosis-forming process we have always to do with long periods of time, as I have emphasized; in the most severe forms really with the whole life. That is indeed quite right. We perform, however, good service even if we only retard the deforming process with palliative remedies and there are even cases where a severe constitutional scoliosis has come to a standstill under palliative treatment.

If we make practical conclusions from these considerations, in every case where we have the task of treating a scoliosis-forming process, that is in the case of every beginning or advancing scoliosis, the first thing to do is to take measures which can remove the primary cause of the deforming process and then other remedies are to be drawn upon which, without regarding the cause of the disturbance of the loading equilibrium of the spinal column, are capable of restoring this equilibrium.

What are now the remedies which might come into question? There are two classes of them: first those which are able to increase the carrying power of the spinal column, second, those which are capable of reducing the load.

In the first place as means of strengthening the spinal column may be mentioned our physical curative methods. In the very beginning massage, electricity, hydrotherapeutic measures, thermal excitations and the like and then the curative gymnastics.

With massage and like treatment we do not indeed influence directly the spinal column but we can influence the circulation near it and so obtain advantages for our purpose by, in this way, exciting the nourishing processes in the vertebræ.

That is the basis upon which the use of massage in the treatment of scoliosis rests. Its aim and its effective possibilities lie in the strengthening and in the increasing of the carrying power of the spinal column. Its regular and effective use in the form of back massage is indicated in every case where it is a question of a scoliosis which is in a stage of development or becoming worse.

How the massage is to be carried out so as to obtain the best results, how and in what form the above-mentioned physical curative means other than massage are to be employed I will not go into here. They are things of minor importance.

We must, however, devote a more thorough consideration to *curative gymnastics*.

Gymnastics have played an exceedingly important part in the treatment of scoliosis for a long time and in all parts. There have been and there still are doctors who consider gymnastics as the foremost remedy in the whole range of scoliosis therapy, and there were and still are such as see in it the only really employable and successful remedy. At the same time we find when we look through the works on scoliosis gymnastics that there is very little about the theory of its influence and what we find is particularly contradictory and will generally not stand a sharp criticism.

Here also it is a crying necessity to establish a firm foundation. I think that this may be obtained by examining what curative gymnastics can do to satisfy the indications set up by us. From this it will be possible to induce the field of employment of scoliosis gymnastics. We shall obtain certain and sure opinions about its usefulness and a judgment concerning the value of the varying gymnastic methods.

The vital principle of scoliosis gymnastics consists in the carrying out by the patient regularly over a prolonged period of certain motions by which the muscles surrounding the spinal column come into action and the single parts of the spinal column are moved against one another. Generally the exercises are so carried out that the bent parts of the spinal column are brought into positions opposed to the curvatures. The intention which is generally followed in these active corrective exercises is to give the deformity an influence for good. Therefore corrective intentions generally are the aim followed by scoliosis gymnastics. Whether and to what extent these aims are attainable we will investigate in the discussion of the means of correction. Here in the first place we will occupy ourselves with the question: how and whether gymnastics is a means of

bringing the deforming process to a standstill. To do this the gymnastics would have to be able to reduce the load upon the spinal column or increase the carrying power of the spinal column.

It is hardly probable that anyone will assert that we reduce the load on the spinal column by means of gymnastics. Even when we prescribe exercises with apparatus which diminish the load on the spinal column during the exercise or when anyone prescribes the so-called crawling exercise, we cannot seriously make such an assertion. The time during which this diminution occurs is as nothing compared with the time in which the load exercises its full weight.

The specific quality of gymnastics, which we here have to reckon with, consists in the fact that gymnastics compel the spinal column and its appendages to do some work. That is a factor with which we really can reckon.

We know that the bones and muscles of a man who works energetically with his body are stronger than in the case of one who exercises his body to a less extent. We know further that the bones and muscles can be strengthened by exercise. Therefore we may come to the conclusion from this that a backbone which is too weak for the task imposed on it may be strengthened by work in the nature of exercise and we obtain a prospect of equalizing a disturbance of the loading equilibrium on the spinal column by means of curative gymnastics.

In this way we should have the same indications for the gymnastics as for the massage.

This conclusion, gentlemen, is quickly come to. It corresponds to the general estimation of gymnastics as a means of treating scoliosis and, when I say it here, could hardly be contradicted. And yet I should like to place it under the lens of a sharp criticism again.

Scoliosis arises when the spinal column is not able to perform some definite, in itself, physiological work. It is a sort of fatigue disease. But otherwise we do not treat fatigue diseases with excitations of energy. An eye which has been overstrained is not treated by any doctor with reading exercises. On the con-

trary the first order which the oculist gives is to forbid or, at least, place a limit on reading. We, however, gentlemen, treat the spinal column, which suffers a curvature as a result of overstrain by giving it work to do which, up to the time, is unknown to it and in which it has had no practice! This comparison is, like all other comparisons, naturally a little lame; even if an excitation to work is injurious to the overstrained eye, it is not by any means proved that it may not be employed with beneficial results in the case of the spinal column, under circumstances which possess a certain similarity. This comparison, gentlemen, should show us, however, the necessity of a serious examination of this question.

How shall we set about this examination?

Theoretical considerations cannot have the last word here. We must here rely on the experiments of practice.

As already mentioned, gentlemen, gymnastics are everywhere regarded as an excellent means of treating scoliosis. An especially good point about it is the fact that it can at least do no harm, it is said. As positive results of gymnastics are quoted, the facts that mild scolioses are cured, medium ones improved and in severe deformities a retardation of the deforming process is said to have been attained.

A favorable influence on the deforming process is thus asserted and in institutions which can boast of particularly exact work, measurement diagrams and photographs are shown as proofs of the correctness of this assertion and which in point of fact appear to confirm those results of scoliosis gymnastics.

I say emphatically appear, for in fact these photographs and measurement diagrams prove nothing!

The spinal column is a movable thing and it can carry out movements which to a very great extent can cloak scoliotic deformities. How difficult it is sometimes, gentlemen, to form a good view of the scoliosis on the patient undressed before us. How often must we make use of special tricks before the child forsakes the stiff position which it has taken up for the examination and lets us see the back in an indifferent position. How often are we astonished to find that then a totally different

picture appears to that which we had seen on the first glance!

Further consider the following: As soon as a child comes into treatment for scoliosis and particularly when a gymnastic cure is begun, the child hears at every step, "Keep your back straight." All gymnastics carry out corrective exercises, that is exercises which are specially qualified to cover up the deformity. Well-drilled scoliosis patients are perfect contortionists. They learn to control the movements of their spinal column in a most astonishing way and at the same time they learn to cloak even considerable deformities. In this way, of course, the deformities do not disappear. But as soon as the child comes near the doctor, or under the eyes of its parents, or as soon as it itself thinks of scoliosis it stiffens up the muscles of its back and sets its spinal column in apparent correction.

Here is the source of the most disastrous disappointment.

Everyone who works with such scoliosis measurement diagrams will tell me that they must, of course, never be taken in such correction positions, but that the patient must be induced to take up a medium indifferent position. Quite right, but how shall the indifferent medium position be found? The child indeed by movements of its muscles can also even stop an apparent progression of its scoliosis. Who can tell me where between the two extremes of greatest possible apparent correction and the greatest possible apparent fault, there is to be found the indifferent mean position? Nobody.

If we want to work with measurement diagrams or with photographs, as a proof of the results of scoliosis correction then we must totally reject all diagrams which do not show changes which do not go beyond the possible degree of apparent correction. Only then do these pictures have any power of proof, when they show differences which could not have been attained by active movements of the spinal column. If one specializes these rules which hold good for the whole therapeutics of scoliosis, for the gymnastic treatment, one has to say, that up to the present, diagrams or photographs which show successes obtained by gymnastic cures have not been shown.

All the results of scoliosis cures which we have noted above lie in the region of the possibility of apparent correction.

It might go, gentlemen, still more against your grain, when I put the further question: can perhaps gymnastics have an injurious effect in the treatment of scoliosis?

No one will deny that, in spite of gymnastics, scolioses may suffer severe aggravations. When this takes place the general explanation given is, that not enough gymnastics have been done or that the process was too bad for anything more to be done than to produce a retardation. Of course it is always asserted that a retardation has been attained.

The first to assert that scolioses were aggravated at least sometimes, not in spite of gymnastics but through gymnastics, was Chlumsky. Beside him I have also appeared with the assertion that gymnastics could have an injurious effect in the treatment of scoliosis. Up to the present we two are probably alone.

The question, however, is so important and I am so convinced that we two, in spite of our isolation, are right that I must, here, lay our point of view clear.

Anyone who treats a fairly large number of scoliosis patients by means of gymnastics will have a source of satisfaction with a certain proportion of them. The children show visible improvement, they take on fresh colors. Their bodies become firmer and the impression is forced upon the most doubting doctor that the scoliosis is coming to a standstill, is undergoing an improvement. In such a case gymnastics cannot have done any harm.

Alongside these children there is also a number who are not a source of satisfaction. They begin their cure alright. But it does not last long before they miss, at first one, then several days from the hours of treatment and finally they remain away altogether generally without any explanation being given.

I recommend you, gentlemen, to follow up these cases which you as well as I have experienced. You will then hear the following from the parents and the family doctor: The child has not been strengthened by the gymnastic lessons but has plainly

suffered from them! Even before it was not in exactly perfect health, that is why the gymnastic lessons were begun but the hoped for strengthening did not appear. Rather the whole being of the child became characterized by an increasing slackness. Loss of appetite, disinclination to work, chlorotic complaints were more clearly to be seen every day, and the improvement of the carriage of the body which was specially counted on did not appear. After stopping the gymnastic lessons the child slowly attained the same degree of health as before the gymnastics.

When you, gentlemen, examine such children about whom you hear such things, and if you are in a position to form an objective opinion about your own work, then you will only be able to confirm what the parents and the family doctor have said. And if you examine the backs of these children you will find that the scoliosis has never improved, but on the contrary generally become aggravated to a most pronounced degree. You will also concur when the parents and the family doctor blame your gymnastic cure for the breakdown of the patient and the aggravation of the scoliosis, if you have convinced yourself by going over a fairly large material that it is not here a question of a single case, but that of a regularly repeating, typical occurrence.

Therefore, gentlemen, do not shrug your shoulders over the cases which remain away from the gymnastic lessons but follow these patients up carefully. You will then come to the same opinion as I, that although gymnastics can perform very good service in cases of scoliosis, yet they can break down and that even injurious effects may arise.

With this conviction one arrives at a difficult position. What is to be done now? Shall we reject a remedy which performs such good service in so many cases? No, we must only stop treating every scoliosis with gymnastics and we must learn to distinguish those cases where gymnastics form a remedy to be employed, from those where we cannot reckon on a reasonable success.

Is this distinction possible? Yes, the excitement may also be employed even in the case of fatigue diseases, only one must not

forget the rest; the condition of weariness must not be too great and the whole organism must have a great reserve of reactionary power! That also in the case of scoliosis!

A gymnastic cure must not be simply written down on the programme of the daily life, but we must place a few considerable limitations upon it. Especially suitable for gymnastic treatment are relatively originally strong children and finally such cases where the loading equilibrium has not been too greatly disturbed.

On the whole, gentlemen, you will agree with me but you will also ask me, "How shall we ascertain whether this equilibrium has been greatly or not greatly disturbed? From the degree of the deformity it is not possible to estimate it, then, *e.g.*, in the case of a malignant scoliosis the loading equilibrium is seriously disturbed in the very first beginning but there is only a very slight deformity present. In the case of a severe deformity which has come to a standstill, the equilibrium on the other hand has been restored.

Here, gentlemen, I should like to draw your attention to something which I have described in various works and which I have also touched upon in my article to-day—the *insufficiëntia vertebræ*.

By the presence or absence of this symptom-complex it is possible to judge whether, with very few exceptions, at any time there exists a misrelation in the loading of the spinal column and it is possible according to its greatness, to estimate the amount of the disturbance of the equilibrium. Thus the *insufficiëntia vertebræ* is not only an excellent aid in the setting up of the prognosis but it also gives us an important criterion when the question is whether gymnastics would be beneficial or not.

Allow me, gentlemen, to sketch in a few words more how the *insufficiëntia* are seen in the case of scoliosis and how we can utilize the condition of things for our therapeutics.

When scoliotic patients come into our consulting room, they seldom complain about anything else than the deformity. Only elderly patients complain about pains in the back, sides, and in the front of the body. We are also not used to inquiring

about subjective complaints in the case of scoliosis. If we do so we obtain more often than we expect the statement that there are troublesome pains in the back or at least, that feelings of fatigue are experienced. If we tap along the spinous processes, we come in very many cases one might say regularly, to painful spots. These are generally to be found on the vertices of the curves. Sometimes their region is larger, sometimes smaller. Also pressure on the lumbar vertebræ from the abdomen is almost always painful in the case of scoliotics.

This is the usual state of things in the case of youthful scolioses.

In the case of real rhachitic scolioses with very small children it is generally not possible to prove the painful spots. The sensibility to tapping in the line of the spinous processes is missing also often with scolioses which occur with a flat back.

If one examines a large number of cases for these painful spots and observes the cases over a fairly prolonged period the following may be clearly noticed.

These painful spots are there when a scoliosis is forming or being aggravated, that is when, according to our etiology of scoliosis, there is a disturbance of the loading equilibrium. The pains are so much greater according to the speed at which the process of aggravation goes on, the more unfavorable the whole prognosis is, that is, the greater the disturbance of the loading conditions is. The pains diminish, they disappear altogether, when the scoliosis comes to a standstill, that is when the loading misconditions are counterpoised.

From such observations may the means sought for, be found, which will give us the key as to what we have to expect from a gymnastics cure.

Cases in which there are no symptoms of insufficiency present, and where the general constitution lets us suppose a good reserve of reactionary power, may be treated with gymnastic treatment without any worry. Good results will be obtained. Cases, however, which show severe symptoms of insufficiency are at first to be kept completely away from gymnastics. First in other ways the equilibrium is to be, at least approximately,

restored, and then one may try how gymnastics can be *tolerated*. One must be very cautious and check the painful spots more carefully during the treatment. As soon as the pains increase, diminish the gymnastics or stop them altogether. In cases where the symptoms of insufficiency are of medium degree one commences just as above.

If one does not do so, if one takes these patients with pronounced insufficiency energetically in hand because the cure does not go on properly then one will experience the relapse, the breakdown of the patients as I have previously described. And the final result for the scoliosis will not be an improvement or a cure but an aggravation, and this aggravation, gentlemen, will not arise in spite of, but because of the gymnastics.

The means with the help of which we can restore the disturbed loading equilibrium on the spinal column are still not yet exhausted. There are still those by the help of which we can reduce the load falling on the spinal column.

I mention first lying on the back.

When we lay a patient flat on his back, the spinal column is free from all carrying work.

Ordering a patient to lie on his back dates from the earliest times in the curing of scoliosis. And we can here only recognize it as very suitable to its purpose. It is particularly suitable in the case of small children with rhachitic scoliosis. In the case of older children I lay great importance on their lying on their backs at least one hour daily at best immediately after the midday meal in bed.

A second means which we possess of reducing the burden on the spinal column are the supporting apparati the effect of which is to remove a part of the burden from the spinal column and take it themselves.

These supporting apparati form one of the earliest aids in scoliosis therapeutics a thousand times recommended and as often useless, indeed combated as injurious.

Are they useless? Are they injurious? When are they useful? When are they injurious? Which apparati are employable and which not? With what precautions may they

be used? Those are quite a number of questions which we must answer here.

According to our opinions concerning the origin of scoliosis supporting apparati have a place in the combating of the deforming process.

The simple rod apparatus, the orthopedic corset, this latter in conjunction eventually with a head rest, they are all capable of taking over load from the spinal column; the rod apparatus to a less degree and only from the lower parts, the corset removes more and its influence reaches further up. If we supply it further with a head rest, the spinal column may be relieved over the whole of its length.

The fact that these machines really attain the desired aim or at least make progress in this direction may again easily be checked by means of the insufficiency symptoms. When you, gentlemen, bring scoliosis with the painful places as described under the influence of such apparati you will obtain in the shortest of time a reduction in the pains to complete disappearance and if you apply these machines in the case of a scoliosis which has become visibly worse you will recognize, with a little observation, that a standstill occurs in the aggravation. In a certain number of cases this standstill continues, in others it is only a pause. In these cases after a more or less short time the scoliosis again makes progress. These advances may even take place at a rate not reached before and the scoliosis may, although more perfect relieving apparati are used one after another, reach finally the highest degree. Whether in spite of, or on account of the apparati may be asked just as in the case of the gymnastics.

How can we arrive at an answer to this question?

The cases which are brought to a permanent standstill by means of the relieving apparati, belong almost exclusively to the group of mild scolioses. The others belong principally to the malignant. The explanation of the double behavior is as follows:

When we place any part of our body under the influence of a relieving apparatus, we obtain always, as undesired by effect,

an inactivity atrophy. I remind you of the atrophy which we obtain when using the relieving apparatus for the legs, even when the disease has no atrophying properties. That is naturally also the case between the spinal column and its relieving apparati. The subject of observation does not allow the atrophying bye effect to be seen so soon and so clearly, but it is doubtless present.

Whether we obtain a favorable or an injurious effect from our relieving apparati, depends completely on what part the atrophying factor plays in our equilibrium example.

If we have a slight disturbance with a disposition to correction, the body will make the best use of the relieving influence in order to again arrive at equilibrium. The great thing is then to remove the supporting apparatus when it has done its duty and not to allow any atrophying effect at all to develop.

If, however, we have a severe disturbance, then, by means of the influence of the relief, the scale inclines to a position of equilibrium. If, however, the inactivity makes itself felt then this again falls into the scale as a new disturbing factor and the minus thus caused can quite easily come to equal the plus attained by our relieving apparatus, it can indeed exceed it. We then obtain a disturbance of the equilibrium equal to or greater than the previous one and our scoliosis from this moment will be aggravated again at the same rate or even quicker than before the application of the relieving apparatus. We then obtain after a shorter or longer interval, a new aggravation of the scoliosis in spite of, indeed, on account of the apparatus.

What have we to learn, gentlemen, from these observations? I think the following:

The scoliosis relief apparatus is, like gymnastics, not a harmless remedy. Where we use it the danger of an aggravation threatens us through its bye effect of inactivity atrophy. The scoliosis relief apparatus is, therefore, only to be used in connection with remedies which work against the inactivity atrophy. And its employability only goes so far as we succeed in combating this inactivity atrophy. At the very least the

inactivity atrophy should not become so strong that it exceeds the positive performance of our apparatus.

Placed in the form of a medical ordinance it runs: Besides the relief apparatus, massage and other means which serve a strengthening purpose are always to be used.

We should thus come to the end of the examination of the means which come into question with regard to the treatment of the scoliosis forming process.

Let us now turn to the means of fulfilling the second indication of the scoliosis therapeutics, to those which might serve for the correction of the deformity, and subject these to the same examination.

Here I should like first to mention a few remedies which used to play a great part, but which are, to-day, seldom heard of. I mean principally the so-called functional adjustment. There was a time when the functional adjustment appeared to be the *deus ex machina*, when the orthopedic science was at its wits' ends. Old beliefs have had to make way for the exact researches even in orthopedics. There is nothing said in modern works about functional adjustment. I will not bring out that old ghost here again, I will not make any attempt to kill it completely. Belief in such things only dies slowly; but still quickest when it is ignored.

I will also not argue with the premise; that one should correct scoliosis by raising the tone of the muscles of the spinal column on the convex side of the scoliotic curvature. The back muscles run over the convexities and concavities in every scoliosis. That it may be possible to raise the tone of a certain portion of the long muscles without also producing a raising of the tone of that part of the muscles which runs over into the convexity, that is, a little trick that I do not think at present possible. And even if it succeeded, it is too childish an idea to think that sufficient strength would become free to bend back a scoliotic spinal column into its place. Only look at the alterations in the bones of a scoliotic skeleton, gentlemen. There can be no mistake that a far greater strength than that supplied by tone

differences is needed for the re-forming of such large and so seriously deformed bone masses.

If we come to means of correction whose working we can really imagine, we must, in the first place, devote a few words to the strength of the body for self-correction. The body is capable of a considerable self-correction with regard to static loading deformities. I draw attention to the rhachitic leg curvatures.

That the body can also remove scoliotic deformities by means of self-correction is not to be doubted which I have already often pointed out. The mild scolioses often disappear with the complete development of the body without any treatment having taken place. Those are doubtless self-corrections. Certainly the re-forming processes which have taken place there are not very great. I have not yet seen a really severe scoliosis disappear in such a way neither have I seen any considerable improvement. I do not regard the reports which now and then crop up in the literature without a certain measure of doubt.

We do not know in which way the living body brings about the correction of the milder scolioses. I presume that the longitudinal growth plays some part in it.

Scoliosis gymnastics are also still esteemed as a corrective means. When examining their utility with regard to the treatment of the deforming process, we several times touched upon their utility as a corrective means. Here we must go into this question more thoroughly.

The plan which forms the basis of correction cures when gymnastics are employed, is the making flexible of the spinal column by means of exercises; the flexibility shall allow the straightening out of the deformity and the muscles, strengthened by the exercises, are to keep the spinal column in the correction form obtained by the bending back, until a re-forming of the bones has taken place. Generally it is pointed out that scoliosis is primarily a contraction of the joints and that these plans of treatment are formed after the type of treatment of such contractions.

The primary mistake lies in regarding scoliosis as a contrac-

tion of the joints. Just as little as a juvenile genu valgum, or a rachitic genu varum is a contraction of the joints, just so little is scoliosis. Just as little as one can correct a genu varum, or a genu valgum by movements of the knee, *just in so much is it unsuccessful in the case of scoliosis*, that is, we do nothing more than bring about a temporary cloaking of the deformity, an apparent correction, but neither now nor at any time a real correction.

According to my firm conviction gymnastics as a means of correction are absolutely useless.

Where the results of treatment appear to prove anything else it is either a question of the self-deception of the medical men concerned, or else the always slight results have been brought about by other means than gymnastics, especially by means of the body's power of correction.

Let us continue, gentlemen. The knife and the chisel which are otherwise our best servants in the correction of bony deformities, cannot be made use of in the struggle against scoliosis. The few attempts which were made in the form of the resection of the deformed ribs, will, I hope, never be made again. I have assisted my teacher, Hoffa, at such an experiment. The impression which we had at the time was expressed by Hoffa in the words "Only once and never again."

Among our outfit for the correction of deformity there still remains mechanical pressure and strain. What these means are able to perform when used in the right place and in the right way I will show by the dressing of a club-foot and will point out the successes to be obtained thus.

Let us see in what form we can apply pressure and strain to a scoliotic spinal column and what results we thus obtain.

I must here name two forms of the use of mechanical pressure and strain which are usually but falsely regarded as massage and gymnastics; these are manual rectification and rectification with the help of the stationary rectifying apparatus of our gymnasiums.

We usually exercise the manual rectification in connection with massage or in the intervals between the gymnastic exer-

cises and they usually consist in applying a considerable pressure with the hands with the idea of bending the deformity back. In the use of the rectifying apparatus the same effect is obtained by the apparatus. The difference is that we can let the apparatus work longer than the hands.

The momentary effect of these rectifications is very striking. Rib deformities of considerable size can be totally pressed out of existence, the curvatures can be corrected, indeed, pressed to overcorrection, but the deformity returns with the removal of the pressure and the most careful observation cannot ascertain a gain in the shape of correction. In spite of that, I believe that manual rectification and the stationary rectification apparatus can show corrective results. *Gutta lavat lapidem!* But great perseverance and patience are necessary, endless repetitions, and the correction obtained is and remains only very slight.

From the stationary apparatus of our gymnasiums to the lying apparati which are principally used by the patients during the night rest is only a very short step and they also exercise a corrective pressure and strain.

These apparati played first fiddle in the treatment of scoliosis by the old orthopedics. Then they went quite out of use as the Swedish drill obtained its, unfortunately false, reputation; quite out of use as the best, indeed, the only remedy for scoliosis. They have again won a place in our therapeutics after Lorenz has given us an up-to-date form in the plaster-of-Paris bed, for the so-called scoliosis extension beds.

The plaster-of-Paris bed may be prepared in such a manner that the patient when lying in it, comes into a position of correction and pressure influences in the sense of correction are brought into action.

I prepare my plaster-of-Paris bed as follows:

The patient is laid upon a bed invented by Nebel in which he lies obliquely in suspension. The back is covered with stockinet. By means of bindings which pass from the trunk to the side rods of the apparatus a correction or overcorrection is brought about. If there is a pronounced hump on the back

then I place opposite it on the flattened part of the back a bolster of felt and wadding. Now the back and sides of the patient are covered with plaster bindings and with loose materials dipped in plaster so that a sort of jacket is formed which reaches up to the edge of the hair, which is continued upward on both sides above the height of the shoulders and holds them with a piece, the lower edge of which runs as far as the gluteal folds and the sides of which run approximately as far as the anterior axillary line. After the jacket has hardened it is taken off and dried. During this process the side walls must be prevented from bending up. Then follows the trimming of the plaster bed-jacket. The first thing to do is to remove the bolster which has perhaps been placed on the back and in this way a sort of niche formed opposite the hump. In addition there are fixed on the back surface two iron rods, bent so  and which raise the bed, placed on a horizontal surface, about the width of three fingers. The idea of the cross-pieces is to prevent the patient lying in the plaster jacket from rolling over on to the side with it. In addition sharply projecting felt cushions are glued into the plaster jacket and which press on the highest part of the lateral curvature.

I place my patients in this jacket over night and sometimes for an hour or two during the day. If I have the patient in my institution or if it is a case of a particularly serious deformity I have it extended to the head.

Now, gentlemen, the results of these plaster jackets! I have a relatively high regard for them. The correction effect is generally to be remarked in a relatively short time. Specially clearly are the flattening out of the curvatures to be seen when the top of the curvature has not been quite correctly judged. One then sees a flattening out of the rib deformity alongside the height of the curvature.

At the same time the patients very soon get used to the plaster jacket, it is easy to make, its cost is not too great and it may be used quite a long time (one-half to one year) before it must be renewed.

In the old orthopedics portable rectifying apparati in addi-

tion to the extension beds, commanded the scoliosis therapeutics.

What interest and what work our forefathers devoted to the construction of these apparati is almost incredible. When I was preparing my handbook on orthopedic technic the viewing of the material was no easy task. After discarding what was not indispensable I described and illustrated one hundred such apparati!

With the advent of the extension bed these portable corrective apparati disappeared from the therapeutics of scoliosis. They have also experienced a revival in recent times. They are certainly not allowed an uncombatted existence. Voices are continually heard which deny the use of these apparati, indeed which describe them as directly injurious.

Here also we must subject the utility of these apparati to a critical examination in order to obtain an idea of their field of usefulness and the success which may be obtained with them.

An observation of the success is also here ambiguous.

When portable correction apparati are applied in the case of scolioses at first one has generally the impression that the desired favorable effect is being brought about. This effect soon appears to exhaust itself. One does not get beyond a certain degree with the correction and by no means seldom one observes after the first improvement, an aggravation of the deformity. Indeed the impression is often given that the scoliosis has finally become worse than if it had been left entirely without treatment.

How can we explain these observations again? In the first place the rapid results obtained are generally apparent corrections by which one should not allow one's self to be deceived. The further real correction results attained are not as a rule very great in the case of the usual apparati. As we generally use these apparati together with other remedies of the scoliosis therapeutics, it must appear doubtful whether we have to thank the portable correction apparatus for the gain which is obtained, or some of the other factors at work, notably the body's power of self-correction.

There are two real causes which come into question with regard to the poor results. The aggravation can be a result of the inactivity atrophy in the case of the supporting apparati, or it can be due to the false construction of the apparatus.

The first possibility is settled by what has already been said. Let us take the second.

I should like first to mention a form of the correction apparati which are particularly dangerous. I mean here the bandages of which the oldest representative is the Jörg braces. They are characterized by the fact that they attack a part of the spinal column lying partly above and partly below the part to be corrected and that they seek to straighten out the curvature by exercising a strain between these two points.

The pull of these bandages acts as a static loading of the spinal column. Now as primary scoliosis forming evil we have static overloading of the spinal column. It is quite clear that such a bandage must increase the disturbance of the loading equilibrium: the scoliosis forming process is excited. Further, gentlemen, make at any time the experiment on a bent rod of trying to straighten it out by this means. You will observe that the staff twists and bends and you will see all sorts of alterations except that to a straightening out. An urgent warning against the use of such bandages must be issued.

Just as the spinal column eludes the correction effect by elusive movements, so does it also in the case of most of the other portable correction apparati. Most of these apparati have the constructive error that the fixative part is not sufficiently worked out.

Every portable apparatus which is to serve the purpose of correcting a deformity must consist of two parts, of the fixative part, with which the deformed part of the body is held, and the active part which supplies the power effect for the correction. These two primary parts must bear the right relation to one another and also to the deformity to be corrected. The fixative part must really grip the part of the body and must so hold it out to the correction mechanism that it can really come to do the desired work. The deformed part of the body must not

have the possibility of getting away from the correction mechanism and the fixative part must not be moved by the power of the correction mechanism.

The mistake that the fixative part does not perform its task is the mistake that runs through most of our scoliosis correction apparati.

This is primarily due to the anatomical conditions. The spinal column lies deeply embedded in the body. It can only be easily gripped at its two ends at the head and rump. Between these points we have only the ribs or soft parts to grip.

Most of the machines make use, as fixative part, of some rod construction or some corset such as we are accustomed to use in the case of the apparati for the reduction of the load on the spinal column. In order to see that one cannot even speak of an approximate fixing of the spinal column, gentlemen, in the case of such a construction, I recommend you to apply such a corset to a skeleton. You can then perform all the movements with the spinal column which it could carry out in life. Now if you switch in one of the many forms of correction mechanisms you will see that the spinal column possesses every possibility of eluding the work of this mechanism and that this work makes itself first felt in the dislocating of the fixative part.

We must not be surprised if we do not attain anything good with these apparati, indeed, if under their influence we obtain the well-known and undesired picture of a very pronounced rib deformity and a sort of lordosis formation at its highest point.

Must we, therefore, quite discard the portative correction apparati? Certainly not! But they must be correctly constructed.

Here we do not need to look for new corrective devices. We have more than enough of them. The point is, that we must have the most perfect imaginable fixative device as basis for the whole construction. In addition to this we must grip the spinal column firmly on the points where it can best be gripped, viz., at the head and the rump. If we exercise a strong extending strain between these two points we stretch the spinal column

between its two extreme points, and, if we now cover the body with a closely fitting covering we have, if not an ideal fixing of the spinal column, at least one which makes the avoidance of the correction pressure very difficult. If we switch this in now in a suitable direction and do not give it a too great or too slight power then we may reasonably expect to obtain favorable results. We may hope to obtain results which may really be recognized as such and we may hope that unintended and undesired by-effects will not nullify or exceed the corrective results.

Whether this calculation is right or not must be shown by experiment. I have made such experiments and will inform you of the results of this extension cure.

The apparatus which I constructed for this purpose consists of a drill corset and an apparatus quite separate from it, which grips the body at the rump and the head. In addition it has pads which exercise the corrective pressure.

Recently I have simplified the apparatus by going back to the supporting corset and constructing the correction corset.

A head rest is built on to this corset which is further very firmly set on the hips. A pair of powerful side rods go round the shoulders with a ring. At the tops of the rings on both sides there is a serpentine of strong springy steel wire which runs up the side of the neck. The upper ends of these serpentines are connected to a ring which presses against the undersurface of the ball of the head. The side rods are so constructed that they can be made longer if necessary. In case of such a lengthening the corset presses against the crest of the *iliac* bone and the head and so effects the desired extension of the spinal column. A spring which presses a pad against the summit of the rib deformity serves as correction mechanism. The amount of the pressure as well as the direction are naturally to be altered. I have allowed the patient to wear this corrective apparatus the whole day. It was only removed for the massage to take place. At night the patient was laid in an extension bed.

What sort of results have we thus obtained?

At first, of course, very rapid and very beautiful apparent results. Severe scolioses appeared to disappear in the twinkling

of an eye. But they were only apparent results. As soon as the apparati were left off, there was the deformity again. But after a time the result of the correction remained for a certain time.

I explain the difference so: In the first place the correction movement is only a movement of the joints and takes place in the spinal column. There are, however, pressures and strains in the material of the spinal column and these begin to alter its form. They do this first with the soft masses, the discs between the vertebræ. If there has been correction work here then the result remains a little while. But only for a while, for the contrary alteration in form takes place just as quickly and leads again to the full deformity. If we let the apparatus continue its work then, in the end, the vertebræ cannot avoid permanently the altering influence of the pressure and strain, and as far as these activities go, so far we must have a real correction. Such results are permanent if we do not allow ourselves to be robbed by a fresh breaking out of the force disturbing the loading equilibrium of the spinal column. In such a case even a really cured scoliosis would suffer a rapid relapse. That is, however, something quite different to when an apparent correction disappears.

I will not here go into what is done with regard to the danger of relapse in these cases. It corresponds to the preventive measures against relapse after the plaster dressing which I have to refer to later. I should like to add a few words about the usefulness of these cures. There can be no doubt that really noteworthy results can in fact be obtained by means of these cures. The results are even quite satisfactory. I have become particularly conscious of this just now after having again examined the whole of my material. In these cures it is an especially pleasant feature that such critical times do not occur as those we experience in the rectification cures immediately after removing the plaster dressing. The patients are generally quite willing to undergo the cure. There is, however, in the public and even among medical men a great feeling against plaster dressings, especially in the treatment of scoliosis. If we give the

patients the choice between a correction in a plaster dressing and one in a correction corset, they invariably choose the latter.

In spite of this I have gone over from the use of these cures after having formed a firm opinion about them, and for the following reasons. The cures were too dear, as the patient must be retained very long in clinical treatment. Only one who is really an expert can perform anything really good with these apparati. Besides this, the slow course of the cure makes it a severe trial to the patience of doctor and patient, and in the length of the treatment the possibility of disturbances by means of uncontrollable influences is altogether too great. If I could find it possible to take these patients into institution treatment for a sufficiently long time, I should willingly revert to these extension cures again.

In any case I have learned from my experiments that one can do very much more with a portable correction apparatus than I used to believe and I have made use of this for my rectification cures by now adding a corset treatment in conjunction to the rectification cure. In still another point have the results of these experiments proved very valuable to me. Relatively often elder patients come to me, such as have passed their thirtieth to fortieth year and who have been burdened with a severe scoliosis from their childhood. They do not come to get rid of the scoliosis, but because they have got severe insufficiency symptoms in addition to their old burden, and are tortured by these. In these cases I am quite willing to give those extension corsets in addition to massage and plaster bed. I do this, of course, to combat the insufficiency symptoms. But also alongside the great relief which one can afford the patients, we obtain regularly correction results which in many cases are quite noteworthy. I have in some cases attained an extension of the spinal column of a hand's breadth and more and maintained them. I should like to recommend urgently this treatment to greater consideration.

Redressement.—I come now, gentlemen, to the best friend of the orthopedist: plaster of Paris. This friend without whom we

really could not make any cure at all, remains true at our side, when it is a question of attacking scoliosis. But we must know how to use it.

The first who brought plaster or Paris into the treatment of scoliosis was Sayre. An historical retrospect is often very instructive! Sayre recommended the plaster jacket: the "Gypskorsett" as we are accustomed to name this thing in German. The idea of the plaster jacket, however, was not approximately that of a portable correction apparatus but, as Sayre emphasized in his publications, his plaster jacket was to be nothing more than a support. It was to do nothing more than maintain the correction position attained by means of a slight suspension. He hoped in this way to hinder the advance of the scoliosis and obtain a slowly advancing improvement.

It could not be otherwise than that the plaster jacket, counter to the expressed opinions of its maker should be used as a real correction apparatus. That came about quickly and from different quarters. The literature of the time bears witness to this. The study of this literature is of extraordinary interest. First all the writers are enthusiastic. The so long and so fruitlessly sought for means—it was at a time when the old scoliosis therapeutics had been utterly forsaken in favor of Swedish drill—had been found at one stroke. Every scoliotic was placed in a removable or nonremovable plaster jacket. At the same time energetic rectification operations were carried out. The successes were wonderful! All at once these reports stop. As much as had previously been written about this, one suddenly finds hardly a notice. Why and wherefore? That is only to be taken really from scattered and occasional reports.

The experiences which that period brought to light are these: In a part of the cases treated with the plaster jacket, a standstill, improvement and even cure of scoliosis was obtained. These favorable results were obtained with those scolioses where the same thing could have been obtained by other means: it was in the case of the forms which I have described as mild scolioses. The malignant scolioses which since the beginning had caused so much worry and for which a remedy had been

sought with the greatest longing and which was believed to have been found in the plaster jacket—these malignant scolioses, when brought into the plaster jacket, might have been arrested in their aggravation curve. They could also be improved on the application of the jacket, in part even to a very great extent but sooner or later the stone began to roll again and ran downhill just as quickly or even quicker than before the application of the plaster jacket.

Taking one thing with another: the era of Sayre's plaster jacket ended with a great disappointment. The disappointment was so great that, at least here in Germany, it was looked upon as a mistaken treatment to handle a scoliosis in a plaster dressing.

It required a certain amount of courage to take up the apparently totally lost cause again. In spite of that I started with it in 1898. Calot provided me with the inducement. Wullstein also who without our mutually knowing anything about it, first might have received the incitement from the same quarter, again took up the plaster treatment of scoliosis. At the time Wullstein's works obtained much greater consideration than my publications. In particular the Wullstein rectification apparatus, which is excellently worked out, has been taken up in most of the greater orthopedic institutions. In spite of this the movement agitated by Wullstein and me soon died away. Although I always, at the orthopedic congresses, spoke up for the redressement of scoliosis and was supported in this by Wullstein, yet there were only a few colleagues as permanent disciples. Most of them returned to their old methods of treating scoliosis again after short experiments. Why? They had approximately the same experiences as those to which the use of the Sayre jacket led in its day. When I maintained that I had obtained other results, when I attempted to prove my assertions by reports, by showing patients, by photographs, I continually met with doubts. And it really was so and is so.

What is the reason for the difference? When I asserted that I had obtained favorable results with the redressement of scoliosis and when others could not obtain them, then I must explain

where the difference comes from. This explanation is as follows:

The difference is, that immediately in the case of my first experiments, I took a sharp set of indications and always remained faithful to these indications. This indication position was correct as is proved by the success of my cures. But the importance of this indication position, its decisive importance for the success or the nonsuccess of the redressement cure has, up to the present, not been understood by most of our colleagues and still less taken into consideration.

The punctum saliens of the scoliosis redressement, gentlemen, is not whether a patient is treated in a Wullstein or Schanz or any other frame, or whether one applies a dressing according to Lovatt or Abbott, not whether one only carries the plaster dressing up to the head or puts the head in it also, not whether one cuts holes in the dressing, whether one includes pressure pads in it or not, no, these are all questions of minor importance, the critical factor which decides the success or the nonsuccess of the cure is the indication position!

As long as I have written and spoken about scoliosis redressement, so long have I been preaching to deaf ears. I repeat the same saying to-day and emphasize it with the whole strength of my voice. When you, gentlemen, listen to what I say here, you will be converted, you will no longer doubt my reports of the good results of the redressement, but you will obtain just as good or even better ones than those which I report.

What is this indication-position for scoliosis redressment? Now, gentlemen, this is the indication position which I have developed for you as the basis of the whole treatment of scoliosis.

Every time we treat a scoliosis we must distinguish between—I will repeat it here again—the scoliosis-forming process and the scoliotic deformity. Every treatment must be made up of efforts which tend to destroy the scoliosis-forming process and those which tend to correct the deformity. Remedies which are very good in the one direction by no means necessarily perform good work in the other. Indeed, what is here very suitable to the purpose may there be just as harmful.

This is the case with all the means of treating scoliosis and also with the redressement.

Redressement is exclusively a means of correction and only suitable for combating the deformity. In that direction it is the most powerful weapon we have in our therapeutical armory to-day. The redressement is, however, absolutely not in a position to do anything against the deforming process. Of course, as long as the dressing is on the patient, so long does it exercise a relieving effect on the spinal column and relieves it to such an extent that even the greatest disturbance of the loading equilibrium is totally put out of action. But in time the dressing is removed and then it is shown that instead of the spinal column having gained in its carrying capacity, it has suffered a loss of it. The misconditions in the loading set to work worse than ever before and the improvement which we had attained by the redressement is followed at its heels by the loss of the correction result. Indeed the aggravation curve after the sharp but only short straightening, begins to increase as we had not seen before and in a very short time has again reached the degree of deformity which the rectified scoliosis would never have reached had it not been treated.

These catastrophes are not unavoidable! Those who knew that in the redressement they took a sharp but two-edged sword in their hands, those who remained conscious of the fact that redressement can never form the whole scoliosis cure, but always can only represent single parts of it, those who keep in the forefront of their minds that besides the redressement, as in the case of every other scoliosis cure, the fulfilment of the second indication, the indication which the deforming process gives, remains open, they will not allow themselves to be surprised by such catastrophes, they will seek ways and means of working against them and these endeavors—I will bring my proofs for this—will not be fruitless.

I should like, gentlemen, to describe to you now the carrying out of the redressement as it has proved so successful with me.

First a few words concerning the choice of cases! The scoliosis redressement is a piece of heavy artillery which is only to be

fired against objects worthy of it. Only severe deformities can come into question, that is only malignant scolioses which have already reached a high degree and which condition a vital disturbance of the bodily forces and the ability to work. Mild scolioses even when they reach the degree of a blemish do not pay by the gain obtained for the costs incurred. Besides this the deformity to be rectified must also have in sufficient degree the ability to be rectified. The impression must be gained at the trial dressings that the torsoskeleton is as formable as appears necessary for the desired success. The complete correction should be the standard of success desired. I will refer again to the fact that such a result can never be obtained but that we must content ourselves with a satisfactory result. According to my conviction it is a satisfactory result when we reduce the deformity from being a disturbance to the health to one which has not this quality.

What is otherwise to be regarded in the choice of the cases, I will lay clear after I have described the whole scoliosis cure as it becomes with the use of redressement. Here only a remark about the age of the patient. There is no certain age. In general better results are to be obtained in the case of young children than with older ones. That, however, is only a generality. Even after the time of growth has been passed one may obtain good results. In the case of a twenty-four-year-old patient, for example, I have had a very satisfactory result.

I subject the patient chosen for a redressement to a short preparatory treatment. By means of manual rectifications and by means of the stationary apparatus the spinal column is made mobile and the patient is accustomed to the use of the rectification frame. After eight to fourteen days the dressing is applied.

The patient is placed for this purpose in a frame. This frame permits of free suspension by the head and extension at the feet which is automatically spread equally over both feet. At first I do not suspend the patient so high as is shown in the diagram but only so high that he can stand on his toes. Then I apply a layer of strips of thin felt, Viennese wadding, and lint around

the pelvis, trunk and throat. Now free suspension and foot extension take place. The first time with only slight force. As soon as possible a plaster dressing is applied beginning at the pelvis and continued up to the throat. At the same time the bandages are drawn very tight in the pelvis region, left a little slacker round the abdominal region and are drawn fairly tight round the thorax again. A cushion of cotton wool laid over the abdomen allows the necessary room for breathing. If the dressing which is reinforced by thin strips of wood, is strong enough, I, helped by one or two assistants, exercise a rectifying pressure with my hands and maintain it until the plaster has become hard. Then I place the patient on his feet again, allow the dressing to harden a little more and then put the patient quickly to bed, where, by means of warming arrangements, a rapid drying of the dressing is provided for.

The whole proceeding is carried out in quite a short time. The really critical time from the moment when the patient is suspended freely and extended, to the moment when he touches the floor again with his feet, lasts five to six, at the very most eight minutes. In addition to good preparations and good schooling of the attendants, the simplicity of my extension frame renders such quick working possible. Pretty as other such frames are, *e.g.*, the Wullstein, the proceeding of setting the patient in plaster lasts a disproportionately longer time. For this reason I have not been able hitherto to disassociate myself from my simple frame.

I do not cut holes in my dressings not even over the concavities. I believe that the fixative value of the dressing suffers in this way. That is after all only a minor question as is also the question as to the introduction of pads into the dressing which increase the correction effect by going further. I never introduce such contrivances into the first dressing. In the later ones I sometimes lay a felt cushion upon the rib deformity and through a hole over it I press it further against the rib deformity. It is quite easy to obtain in this way *decubitus*.

At first I change the dressing at short intervals. After three to four days, at most after eight days, the first change of dressing

takes place with a vigorous repetition of the whole rectification proceedings. At similar intervals there follow further changes until I have gained the impression that I am not obtaining any increase in the correction result.

Now I let the dressing remain until, three months after the application of the first dressing, I remove it altogether. In the meantime dressing changes are only made for external reasons. In such a case I make a plaster bed and take the model for the extension corset, which takes the place of the dressing after its removal.

The patients feel very unhappy at first in the rectification dressings. However, in one to two days they regain their composure with the help of quieting means and expert care and are again quite lively. I keep the patient in clinical treatment during the whole time that the dressing remains on, for as long as the dressing is there, there threatens the spectre of the so-called dilation of the stomach.

In the case of fixed dressings round the abdomen, there arises now and again, as is well known, a peculiar, very dangerous disease in the digestive tract. A swelling up of the stomach and closure of the pylorus. Here there appear to act causatively slight digestive disorders and certain anatomical positional relations of the intestinal organs.

These conditions are introduced by a vomiting. The patient very soon gives the appearance of being seriously ill, and is really in serious danger. With my first patient with such an accident I narrowly avoided the calamity.

If these alarming symptoms appear, then the dressing must be immediately completely opened and the stomach emptied with the stomach pump. In this way the incident is settled. In the case of these patients the continuation of the rectification has to be given up. In spite of all precautions they generally get these conditions again.

When such untoward symptoms do not appear, the patients, as I have already said, feel surprisingly well in their dressings as soon as they are over the first bad days. The supposition which I myself had had when I first began the scoliosis rectifi-

cation, that the great dressing would depress the general condition, a doubt which is continually heard to-day, proved to be false. On the contrary, these children who, on account of their serious scolioses, always show a general condition the reverse of pleasing, undergo a change for the better in their dressing. The complexion improves, the cheeks fill out and the appetite increases.

The cause of this favorable appearance, which was a very pleasant surprise for me, I seek to find in the fact that the rectification, in spite of the closely fitting plaster dressing, produces an enlargement of the chest and abdominal cavities and that the chest and stomach organs are placed in better working conditions.

A decubitus is an unpleasantness during the time of the dressing sometimes. In the case of the sharp gripping with the plaster dressing I cannot always avoid in all circumstances pressure spots. They are of course unpleasant but otherwise they are of no importance.

Now, gentlemen, I must describe to you the picture which the patients offer when they are taken out of the dressing.

When one gets to see the patient at the first change of dressing, that is at most a week after the application of the first plaster dressing, one is at first very pleased. The back is not to be recognized again. A wonderful correction results. But when tried for its durability it is quite a poor thing. In the shortest of times the liberated patient sinks back into his old deformity. The correction result was only caused by movements of the intervertebral joints and bending of the ribs. It was an apparent result, just like the other apparent results which we have already become acquainted with in the case of the other therapeutic remedies.

If the same trial is made with the patient after a few weeks, then we find that the result is much more permanent. We have then already a re-formation in the intervertebral discs, and if one waits a few months the correction result is so permanent that one cannot avoid having the impression that a re-formation of the vertebræ has taken place.

I imagine that during the redressement there is first only a movement—a bending is something quite different—and a bending of the ribs takes place. Further, I imagine that besides these there occurs a development of pulling and pressure strains in the mass of the spinal column itself and that the resultant of these pulling and pressure strains is a re-forming of the mass of the spinal column. I imagine the same thing for the effect of the redressment as for the effect of the portable correction apparati. The only difference is that the power effect in the case of rectification is much greater and that, therefore, its effect is much more intensive.

I even believe that the great pulling and pressure strains which, during the rectification, must occur in the material of the spinal column, produce a sort of reactive inflammation.

I should like here again to refer to an example. When we rectify a club-foot, there also, great pulling and pressure strains are set in action. If we take such a foot out of the dressing before the resultant of the strains has been arrived at, it gives us the impression of a condition of inflammation: it shows swellings, sensitiveness to pressure, the patient is not able to stand upon it.

That something similar goes on in the spinal column, certainly without our being able to see it so directly, I conclude from the behavior of patients on being taken out of the dressing. Already at the time when the trials of the permanence are made, which I have just described, it is to be noticed that the patient does not by any means like the free standing exercises. He looks for support and is very thankful when we allow him to lie down or place his head in the suspension sling. This necessity of the spinal column for support which is thus expressed does not generally become less with the time of the dressing but rather stronger, and it reaches a degree which cannot be explained by inactivity atrophy alone. There also occurs an inactivity atrophy in the redressement dressing. But in other cases where such a thing was to be supposed, I have never seen that it increased to a momentarily visible need for support. Therefore I believe that, under the influence of the sharp pulling and

pressure strains which are set in action by the redressement, a reactive inflammation occurs in the spinal column and in this way a loosening of the bone material, and that, during the period of this loosening, there is present the need for support in the case of the patient.

Be that as it may, at any rate, just as little as a club-footed child is able to walk straightway, when taken out of the plaster dressing at the end of the redressement cure, just so little can the scoliosis patient whom we take out of the plaster dressing after about three months walk away and take his fine correction result with him. The liberation from the dressing, so long wished for, brings a great disappointment with it; he cannot hold himself upright at all: the spinal column is not in a position to carry the burden of the body—not the muscles of the spinal column but the bones of the spinal column.

With this we come with our cure to an exceedingly critical point.

If we load up the liberated spinal column again, if we give it approximately the normal burden to carry then a miscondition of the loading relations again sets in, and this results in the relapse of the deformity. The trunk sinks rapidly to the rectified scoliosis again, indeed the relapse exceeds the degree of the former deformity very much. What can we do to avoid this danger?

We can now only place loads on the spinal column at the same rate as it regains its carrying capacity after the removal of the plaster dressing.

In this case I proceed as follows: Immediately after removing the plaster dressing, I place my patients in a plaster extension bed, which I had prepared for them during the time of the dressing. At first I let them lie quite quietly in this bed similarly to the treatment of a severe case of spondylitis in a plaster bed. The patient only comes out of it for the washing and massage indulged in during the lying. Further for the trials of the already begun and now finished corset. These trials are of course performed under suspension.

Immediately after the removal of the plaster dressing I, at

first, only use supporting corsets. They were leather drill corsets, hip pressure corsets and principally the corset previously mentioned. With this corset I generally let the patient wear a simple head support.

After I had learned that considerable improvements could be attained in severe scolioses by the use of portable correction apparatus, I went over to giving, after the removal of the plaster dressing, not a simple supporting corset, but a correction corset. After I had gained the impression that a loosening of the materials of the spinal column takes place under the plaster dressing, I believed myself justified in supposing that a favorable time had arrived for the work of the portable correction apparatus and that one, by means of these combined cures, must attain better results than with the simple redressment.

Pictures which I reproduce when speaking of the results of redressment will prove that I had not deceived myself.

I, therefore, now carry out the treatment after removal of the plaster dressing as follows: The children have an extension plaster bed and a correction corset. During the early part of the time they only wear the corset a few hours daily. They are continually under the influence of the corset or the plaster bed except when being massaged, electrically treated, or washed. By degrees I have the corset worn the whole day long, while the plaster bed is kept for the night.

Such a difficult cure is only possible when the patient is in stationary treatment. As the stationary treatment is also necessary during the time the dressing is on, these rectification cures make quite a long stay in the institution necessary; five to six months is the minimum.

I do not send my patients home until I have the impression that the spinal column has some sort of carrying capacity again. Some one in the family must then be made acquainted with the use of the corset and the plaster bed and must learn massage. The further carrying out of the cure at home consists in the continuing of the use of the appliances, corset and plaster bed and in carrying out twice daily a vigorous massage of the muscles of the back.

For checking purposes I get the patients to present themselves in my surgery first at short intervals and then at longer intervals.

The impression which I have of the certainty of the result acts as a guide to me in my further prescriptions. The corset is first changed. I remove the extension head rest and replace it by a simple ring head rest, at the same time the pressure pad is removed. After a time this little head rest is only worn for an hour at a time and is finally laid aside entirely. With this I come to the simple corset model which I generally use in the treatment of scoliosis. In time this is also left off. The plaster bed and massage I retain the longest. I continually impress upon the parents of my patients that the massage must be carried on with never-ending perseverance if the end is not to be a disappointment after all.

On the other hand, I have gymnastics indulged in but very little in the after-treatment. In connection with the massage I prescribe breathing exercises immediately on the removal of the dressing. Then later come the well-known trunk exercises which can be performed when lying on the stomach. If the patients do not show any further need for support, we cautiously continue our way with the use of appliances which permit exercises without a burdening of the spinal column and finally arrive at free trunk exercises. If at a later time a corset atrophy develops, or if I am not satisfied with the respiration, then I insist that from time to time a few weeks, gymnastic cure should be made. I demand, however, that this takes place under my eyes. I have a fear of the so-called gymnastic after-treatment at home which I cannot check. Have I not mentioned above that I consider gymnastics a not uninjurious remedy in the case of malignant scolioses, and I can only repeat it here with increased emphasis.

Final results of the redressement. What the redressement results look like immediately after the removal of the plaster dressing I have already described. I have further to say what becomes of them when the cure is continued in the way set forth.

I would give a great deal, gentlemen, to be able to say: "Now, gentlemen, carry out the cure as I have described,

and you will not experience any disappointments; you will permanently maintain for your patients the correction result that you took out of the plaster dressing, or you will even improve on it. As much as I should like to say so, gentlemen, I cannot. I must pour a great deal of water into the wine and report many disappointments.

When we, gentlemen, remove the patient from the dressing, we have, even in the most successful correction, by no means attained the total extinction of the scoliosis or even an over-correction as in a club-foot in approximately the same stage of the cure. There always remains a remnant of the scoliosis. Also we shall never be able to entirely remove the deformity. Dangerous as the "Ignorabimus" is in science, here we may say it, for the anatomical conditions of the spinal column are just a given quantity and they are so unfavorable for the application of mechanical forces that a complete correction results in the case of the scoliosis redressement is impossible.*

If we could at least only retain the picture which we take out of the plaster dressing, we might be quite satisfied. But even that is not possible.

The correction picture that we take out of the dressing is composed of two factors. It is composed of the re-forming that has taken place in the spinal column, the real correction and also there is an apparent correction which has taken place within the possibility of motion of the spinal column. By means of the rectification we produce joint movements in the direction of the bending back of the deformity. What part of the deformity disappears by this means is naturally apparent

* It was a peculiar coincidence that at the time when I wrote this, the news came from America that Abbott had discovered a method of bringing about an overcorrection of the scoliotic spinal column and of obtaining correction results which I here describe as unattainable. At the orthopedic congress this year we have had opportunity of proving the truth of this information. Unfortunately I did not need to correct my "Ignorabimus" because of it. The alleged over-corrections of Abbott are nothing more than thorax deformations. Abbott does not attack the spinal column as we have hitherto done, but the thorax and he presses the thorax round the spinal column into such a form that it simulates a correction or overcorrection of the scoliosis. With the methods of carrying out the redressement of scoliosis which have been hitherto employed such apparent corrections are possible to obtain, it is only necessary to seek out the suitable cases.

correction which must again be lost. When we rectify a club-foot, we overcorrect it as much as the joint movement, which overcorrection is again lost and must be lost.

Therefore, gentlemen, there are no complete scoliosis corrections with the redressement and there will never be any, and also the correction picture which we take from the rectification dressing, cannot be retained in all completeness. In place of the absolutely necessary loss, a partial or even a complete equalization or even a gain may certainly be attained after the removal from the plaster dressing by the use of the correction corset.

If the danger of the primary relapse has been avoided—it is possible to say this when the correction result has been carried on to six months after the removal of the plaster dressing or the correction result—even then everything is not yet won. The secondary relapse can even yet destroy the correction result and a result which appears first class six months or even a year after the correction may after years look really bad. The whole thing is just whether we succeeded in giving the spinal column back its normal carrying capacity in the after-treatment or not. In the first case we have a permanent result and in the second with natural necessity a relapse.

It is not possible to say exactly what time is needed before the danger of a late relapse may be regarded as past. According to my experience I do not dare to speak of it as being over for at least five years.

Gentlemen, if I wanted to sing a hymn of praise to the scoliosis redressement, I would here have a suitable opportunity. But I will not raise this hymn. Instead we will take a short look back and seek for an appreciation of therapeutics in scoliosis redressement.

In the first place I repeat: Redressement is a means which can only fulfil one task in scoliosis therapeutics. Redressement can never gain the importance of the whole of the cure of scoliosis. The measures which have always to be taken in addition to the redressement do not lose their importance on its account

in any way. They are not to be mentioned as an after-treatment to the redressement.

As a means of correction redressement excels all other means competing with it.

The correction result may be, in a number of rectified cases, permanently maintained, indeed even improved. What can always be attained is a sharp descent of the aggravation curve and quite a considerable flattening of its secondary rise.

We must, however, still add that the use of redressement by a medical man demands great interest and full understanding of the treatment of scoliosis, that the patient must be prepared to stand the by no means slight unpleasantnesses which occur in the long period of treatment and must also be prepared to make the necessary financial sacrifices, which are considerable.

From the last sentence I should like to complete what I have said about the employability of redressement in a very important direction.

As trial material for new methods of treatment, gentlemen, we like to choose policlinic and clinical patients: This material is absolutely unsuitable for the scoliosis redressement. You will seldom find the necessary intelligence and perseverance there—never the financial strength.

When the care of the cripples opens special institutions for the treatment of scoliosis, then the redressement of scoliosis will also be attainable for the lower classes of the people. Until then, however, we will keep our hands away from them, for we only get blows in the face. You may believe me, gentlemen, I speak from a rich experience!

Now enough of redressement!

We have now come to the end of the investigation of the means which come into question for the treatment of scoliosis.

We have laid out all the cards we can play in the treatment of scoliosis and given them their values. Perhaps it would be of interest to you, gentlemen, to see a trial game which I will play before you in short, rough features, what lessons I learn from that which I have shown you and how I treat scoliosis in practice.

Let me begin with the great mass of the youthful scolioses, with the mild ones, in these I see my first and most important duty in explaining to the patient and his parents the mild nature of the complaint. It is always a great pleasure to be able to lighten the heart of a worried mother. Further I investigate the patient's general condition of health and prescribe what is to be prescribed. Generally it is an alteration in the diet.

Most of the patients in question are young girls and these again are generally overfed and badly fed with milk, cod-liver oil, sanato-gen, iron and other similar good things. I order a varied, principally vegetable diet with a preference for fruit and fresh vegetables. I get them to tell me how the patient spends his day and provide for the avoidance of mental and bodily overstrain and for sufficient time of rest. Where I get the impression of unsuitable home relations I endeavor to get the patient into other surroundings for a few weeks.

Locally I always prescribe the use of back massage. I train the mother or some other person of the household in it and have it carried out according to specially printed directions once or twice daily with the strictest regularity and absolute perseverance.

If clear insufficiency symptoms are present, or if the case is so, that a clear difference in the hips or even a slight rib deformity is present, then I give, in addition, the supporting corset which I have previously mentioned and a plaster bed. I very seldom propose gymnastic treatment. Generally when it is desired I refuse it.

I only propose gymnastics in the case of strong children without or with only very slight insufficiency symptoms.

In the rare cases where I accept such cases into my institution, I let them do a little gymnastics with great caution in order to provide the children with the necessary bodily movement.

On the special desire of the parents I accept the children to my gymnastic cure if they live in the immediate neighborhood of my institution. I absolutely refuse when the homes lie in

distant parts of the city or even outside the city, as the journey to and from the gymnastic lesson tires the children a great deal too much and undoes what the gymnastics might have done.

Of the scolioses which I do not count under the mild cases, I will first describe the rachitic in their therapeutics. Provided that they come to me in a florid stadium I prescribe antirrachitic general treatment, which may proceed in two directions. I very seldom see rachitic hunger children. These get a plentiful diet rich in fat and albumin. On the other hand, I see very much oftener overfed rachitic children who have never had anything but milk, cod-liver oil with and without phosphorus and such things. These again I put on a vegetable diet, without milk and with very little fat and albumin, a prescription which I should like to recommend for many other cases. In every case I then give these rachitic scolioses a plaster bed and if they are sufficiently young I let them make a lying cure something like in the case of spondylitis. If they are already larger and no more to be permanently kept in a plaster bed they get also a supporting corset. Of course here again massage is carried out regularly.

Now I come to the bulk of the malignant scolioses.

Here I will first mention the adult patients who, burdened with severe insufficiency symptoms, come to me. I give these a supporting corset, generally also a plaster bed, I prescribe massage and warm applications to the painful points. Often I also give these cases phosphorus.

With malignant scolioses at an early age I consider it my duty as a medical man to explain the whole serious meaning of the complaint. Just as much as I console with the mild scoliosis, just so energetically do I paint the future of the patient with the malignant scolioses even when the deformity is only in its beginning. I do this first from personal motives in order to avoid later reproaches and then because the patient will only follow the advice which I give him when the full meaning of his complaint is pointed out to him.

The real prescriptions generally consist of general orders in the first place, as with the mild scolioses. Only I try to get

the malignant cases away from the usual home surroundings. Poor plants often thrive better when set in a different soil!

For the local treatment my prescriptions are different, according to the importance of the already present deformity and what means appear to me to be indicated in the case of correction treatment and which are available.

If there is no particular deformity present or if the rectification for any reason does not come into question, then I give a supporting corset eventually with a head rest and a plaster bed with extension.

Massage of course for all cases. With the gymnastics I am still more cautious than with the mild scoliosis.

I apply the redressement where the deformity has reached such a high degree that it has an injurious effect on the general health; where there is a sufficient ability to be rectified with the deformity and where the external conditions appear to me to guarantee the practicability of the redressement cure.

That, gentlemen, is in short my scoliosis therapeutics.

We have now arrived at the point to which I wanted to lead you. I have told you the goal of my remarks; we want to get an opinion as to what is still wanting to us in the scoliosis therapeutics and to keep a look out as to which way the road goes on.

What we can do in scoliosis therapeutics I believe I have shown without being influenced by the favor or the hate of the parties.

What is wanting?

We may be contented with the capability of our therapeutics with regard to the mild scolioses. The mild scoliosis is and remains a bagatelle. It does us the favor of coming to a standstill and often to a correction without any treatment, with any treatment and often in spite of any treatment.

We hold the mastery of the rhachitic scolioses in the same way. It is only a question of treating the patient at the right time.

With the constitutional scolioses the balance is not so easy to strike. Let us name our positive performances in connection

with it, we can in all cases bring about a retardation in its progress. In a certain number of the cases we can also succeed in bringing the deforming process to a standstill completely. Even this result we cannot guarantee. It is based too much upon certain unknown processes in the interior of the body of our patients.

The ability of being corrected in the case of severe constitutional scolioses is limited by external, particularly social reasons. It is also limited by the anatomical conditions, by the position of the spinal column, on account of which there is always a remnant of the deformity. This remnant is unimportant, we can take it in the bargain. Also we can get on with it when many patients come to us for treatment when the deformity is overripe, that is when it has reached a too advanced degree and when the bone has become too hard. He who does not go to the doctor at the right time must bear the consequences. Now comes the sore point in the therapeutics of the constitutional scoliosis. It is that we are not in a position to maintain the result of a rectification permanently with certainty.

At one time we can do it and at another time we cannot. And we have also worked in the one case exactly as in the other and the one case appeared to lie just like the other.

That we succeed in maintaining the rectification result in some cases proves that we do not stand before an "*Ignoramous*," but an *Ignoramus* is present.

The "*Ignoramus*" is so far limited that we can say the rectification result can be permanently maintained if we succeed in restoring the loading equilibrium of the spinal column.

But how this loading equilibrium is disturbed in these constitutional scolioses—that, gentlemen, is what we do not know. And still less have we a remedy for the prophylactic avoidance of this disturbance or of cutting it out by specific therapeutics.

The admission is saddening. Just at the most important point our knowledge and our art breaks down. And yet this admission is a gain, gentlemen, for it points out the direction of our further researches.

Rational therapeutics can only be based on a knowledge of pathology. The possibilities of therapeutics are limited by the exploration of pathology.

If we have such a failing to chronicle in our scoliosis therapeutics to-day the fault is not to be found in a scrappy working out of the therapeutics. What is possible to attain therapeutically with our knowledge of the pathology of scoliosis that has been attained by the present-day orthopedics. It is not a question of extending the therapeutic methods for further progress. Gentlemen, do not waste your time in the search for new gymnastic exercises. Do not construct new gymnastic appliances, new rectification appliances, do not dispute whether Hessing's corset is better than a leather or a celluloid one, do not debate whether you will apply a plaster dressing after Wullstein, after Lovett, after Schanz or after Abbott, all these questions are details, not worth a stroke of the pen. If you do this or if you do that you will all attain the same, and will all end at the same point.

The further advance of scoliosis therapeutics, the final solution of the scoliosis question is not to be found in the gymnasium, in the workshop or in the operating room, it will not come at all from the orthopedic institution. *The next word in the scoliosis question must come from pathology.*

We ask it the question: The cause of constitutional scoliosis must be a disease process which severely diminishes the carrying capacity of the vertebral bones. What is the nature of this process?

The answer hitherto given: it is a rhachitis, a so-called late rhachitis, we cannot recognize as satisfactory; for the clinical procedure, the clinical finding is quite different in the case of the constitutional and the rhachitic scoliosis.

There is no doubt that this question can be answered, as far as I am concerned. Let us regard the old questions which just in our time have been answered in the sphere of pathology. The answer to our question has never been sought for systematically.

When the question is answered we may also hope to find a

means for a specific treatment of the complaint and so to come to a real etiological treatment of the malignant youthful scolioses.

I have come to the end, gentlemen. What orthopedics performs to-day in the treatment of scoliosis, we need not be ashamed of. What was set us to work out on a given basis, we have worked out. The scoliosis question is, however, not yet solved. It cannot be solved until a new basis for our work is given us.

CONGENITAL LUXATION OF THE HIP.

BY DR. P. LE DAMANY,

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In the correction of the malformations of the human body it is necessary to place in the first rank the treatment of congenital luxations of the hip. The importance of this part of orthopedic surgery constantly increases. To render it of rational and lasting effect it is necessary, or at least extremely useful, to recognize the causes and mechanism of the deformity which we have to cure.

In the study of the development of the human being congenital luxation of the hip forms a special chapter without analogy in the other branches of pathology. We cannot be prevented from following the causes as far as it is necessary in order to have a clear and complete comprehension of them. Our pathogenic researches on congenital dislocation of the hip have led us far from orthopedic surgery and even far from human pathology. The studies of comparative anatomy, ontogeny, normal and pathologic anthropogeny have forced us into the domain of philosophic theories, into that of transformation in particular. To understand the production of this deformity it is necessary to take a glance at certain transformations sustained by the vertebræ, transformations in which the human species is the termination.

The philosophic conclusion of these observations is that man represents the last step of a series characterized by the enormous development of the brain, the excessive breadth of the pelvis, and the extreme length of the femur. The pathologic consequence of this disproportion is the congenital dislocation of the

in so far as provisions of this kind are valuable, we ought to consider as impossible the appearance of a being cerebrally as elevated above man as man is elevated above the anthropoids.

But conclusions of this sort are not justified in a paper such as this. For readers who may have the desire to investigate further I simply add that there may be found a complete exposition of this subject in my book, "Congenital Luxation of the Hip" (Alcan, Publisher, 108 Bd. St. Germain, Paris, 1912). Leaving this elevated consideration, the theories of which appear idle to many persons, we will all agree that the exact knowledge of the mechanism by which the luxation is accomplished ought to teach us to what mechanical principles to turn in order to cure it. They will be the reverse of the causal actions, and except that their direction will be directly opposed they will be directly copied from them.

Two Malformations of the Human Fetus (Torsion of the femur and partial levelling of the acetabulum).—These malformations



FIG. 1.—The ball-like shape of the human fetus in the uterus is excessive. It is in a difficult position.

constitute two anomalies in ontogeny. They belong to a group of skeletal changes peculiar to man. At most, one finds a vague outline of them in the anthropoids. They are due to the extreme difficulty with which the human fetus accommodates itself to the ovoid form of the maternal uterus. Its accommodation to this form is remarkable (Fig. 1). This is necessary on account of the too great length of the femur. No species of animal possesses a femur, the length of which in relation to the other dimen-

sions of the body is at all comparable (Fig. 2). This hyperflexion is obstructed by the too great projection of the anterior and superior iliac spine and the too great width of the pelvis. The ball-like shape is not voluntary on the part of the fetus, but is imposed on it by the uterus wall of the mother. Its thighs strike against the anterior and superior iliac spines and on these projections they rock, like levers of the first class. The result

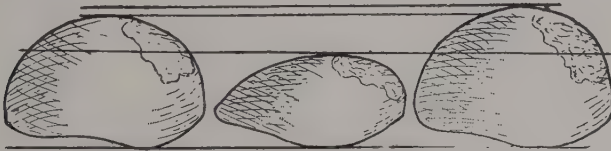


FIG. 2.—The young of quadrupeds, thanks to the shortness of their limbs, are comfortably situated in the uterine cavity.

of this is malformations which easily take place in bones still in the course of development and in great part cartilaginous.

One of these changes is the diminution in depth of the cotyloid cavity and the other is the torsion of the femur.

During the entire extent of life the cotyloid cavity has in all quadrupeds the form of a hemisphere. Its depth in relation to the diameter is the same at birth as at the first stage of intra-



Fetus of six months. Fetus at term. Child of three years.

FIG. 3.—Drawings made after three measurements of the human acetabulum. To facilitate the comparison of the height, the diameters are supposed to be equal.

uterine life. It does not undergo any diminution during the last portion of its stay in the maternal uterus.

In the case of the human fetus the acetabulum is hemispheric during the first two-thirds of fetal life, but during the last three months its depth in relation to its width gradually diminishes. Originally, as among the animals, this depth was five-tenths of the diameter. At birth it is not more than four-tenths. From a hemisphere the cavity is reduced to a third of a sphere (Fig. 3). In adult life the depth of the cavity is equal at least to

six-tenths of its diameter. The cotyloid cavity with its rim has become two-thirds of a sphere. The anatomists have been mistaken in believing that the acetabulum was in the beginning flat like the glenoid cavity of the shoulder. Its lack of depth is peculiar to the human species, it only exists at birth, and is the result of deformity. This change in the cotyloid cavity is full of danger for the infant at the beginning of extrauterine life.

The femur also is deformed. Place on the same flat table (Fig. 4). The femur of a fetus of four months, that of a newly born infant, and that of an adult. Let us suppose, which is true, that the axis of the inferior extremity is parallel to the surface of the table in each case. Here is what we shall then see. In the

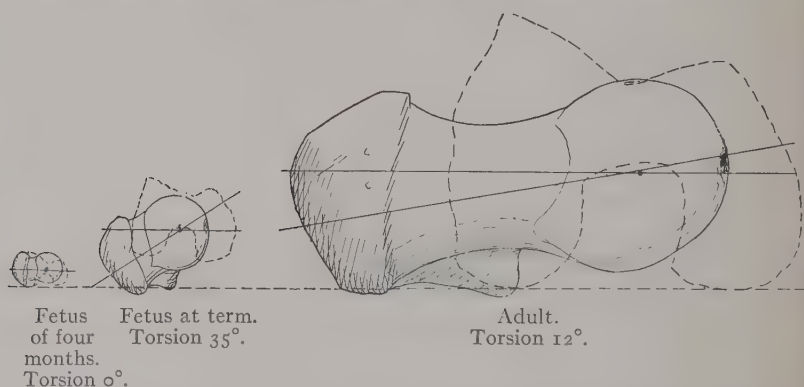


FIG. 4.—Torsion of the femur before birth. Its partial detorsion after birth. The bones are supposed to be placed on the same table and seen shortened through the superior extremity.

fetus at four months the superior extremity will be parallel to the surface of the table; in the case of the fetus at term will make with the surface of the table a considerable angle, varying with the individual and averaging about thirty-five degrees; in the adult this angle will not be more than about twelve degrees. The femur, then, is twisted during intrauterine life and is untwisted incompletely after birth, and the torsion of the femur corresponds to what one calls the anteversion of the head.

Torsion of the femur and flattening of the acetabulum arise from the same mechanical causes. The hyperflexed femur becomes a lever of the first class. The power is the pressure

exerted by the uterine wall on the knee. The fulcrum is at the anterior and superior iliac spine which arrests this flexion. The

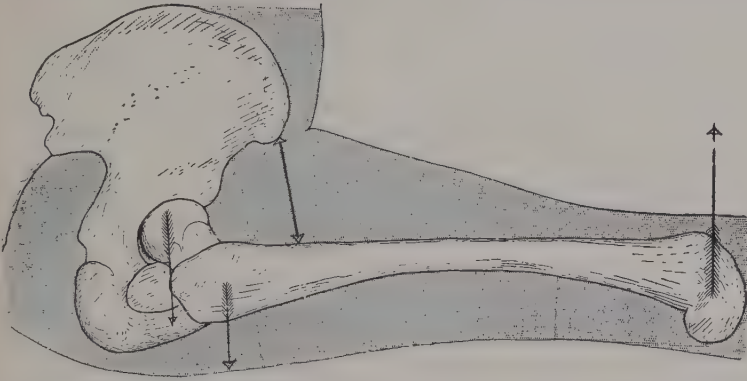


FIG. 5.—Action of the uterine wall of the thigh of the human fetus. The hyperflexion by the tendency to rock on the support of the anterior and superior iliac spines twists the femur and diminishes the depth of the acetabulum.

resistance is at the acetabulum which fixes the femoral head. The disposition of these forces is indicated in Fig. 5. Between

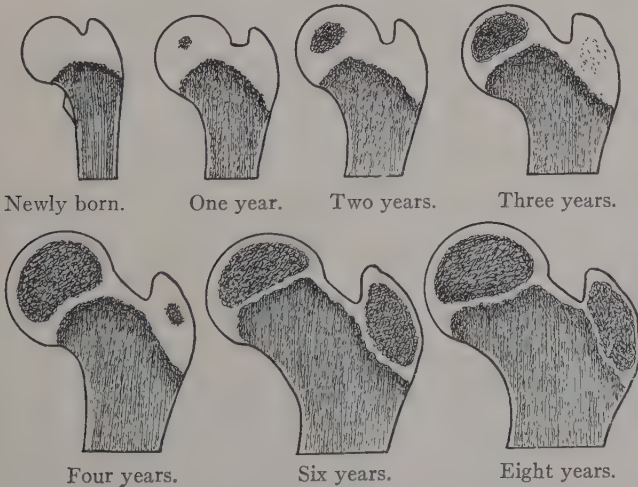


FIG. 6.—Diaphyseal line of the superior extremity of the femur. It is at this level that the torsion and detorsion of the bone is produced.

the iliac fulcrum and the acetabular resistance there is the superior diaphyseal line of ossification (Fig. 6). At this level the

bone is formed of young soft tissue, of cartilage in the process of osseous transformation. At this point by a mere excess of flexion of the thigh the superior epiphysis turns on the diaphysis slowly but progressively. The trochanter is displaced, approaching the ischium, while the head of the femur remains fixed. The torsion of the femur is nothing but this rotation of the superior epiphysis on the shaft of the bone.

After birth it will correct itself by a similar mechanism, but in the opposite direction, in the progress of the adaptation to

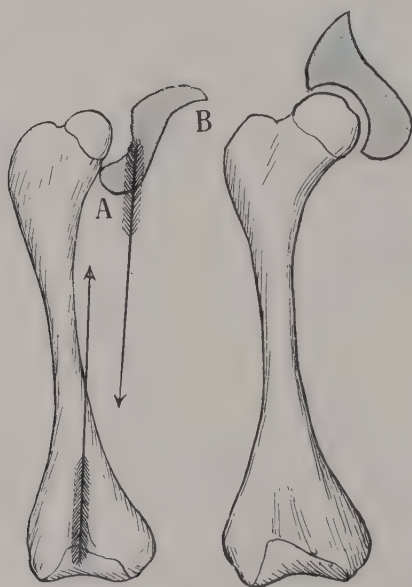


FIG. 7.—Normal hip and hip with bad conformation through poor orientation of the articular cavity.

dorsal decubitus and the upright posture, the two characteristics of man. The cause is the forcible extension of the femur demanded by these two attitudes. The necessary support is furnished by the anterior vertical fibers of the articular capsule in a state of tension.

The torsion of the femur results from the difficulties which the human fetus has to adapt its form to that of the maternal uterus. Detorsion is caused by the difficulty which is experienced in

putting the femur in a position of sufficient extension for the upright posture.

The atrophy of the cotyloid cavity during the last months of intrauterine life is due to the same cause as the torsion of the femur. From the continuous push exercised by the uterine wall on the inferior extremity of the thigh (Fig. 5) there results a diminution in the pressure exercised by the pressure of the head of the femur on the acetabulum. Now, it is the pressure of this head which hollows and molds the cavity. If this is suppressed the acetabulum atrophies very quickly. By well-combined experiments it is easy to reproduce both these femoral



FIG. 8.—Embryo of three months with luxation of the right hip through bad position of the thigh.

torsions and these diminutions in the depth of the acetabulum. If certain observers have obtained different results it is because they have not sufficiently studied the conditions which permit of their production. But in nature they are absolutely peculiar to man. They exist in every human fetus, and from their exaggeration results the congenital luxations of the hip, or rather a category of these luxations.

Before going further it is necessary for us to show the pathogenic multiplicity of congenital luxations of the hip. Indeed, to thoroughly understand the congenital coxo-femoral dislocations that the surgeon treats it is necessary to know that there

are other kinds and that the whole forms a complex group in which a classification is necessary. They can be divided into teratologic luxations and anthropologic luxations.

1. *Teratologic Luxations*.—They have varying mechanism and numerous causes so that we can subdivide them in the actual state of our knowledge and reserve for ourselves the possibility of adding new categories in the future. (a) Luxations through malformations of the pelvis producing a bad coaptation of the articular surfaces (Fig. 8). (b) Luxations through an excess of flexion of the inferior member (Fig. 8). (c) Luxations through exaggeration of the obstacle which limits this flexion (eventration through umbilical hernia, retention of urine, etc.)

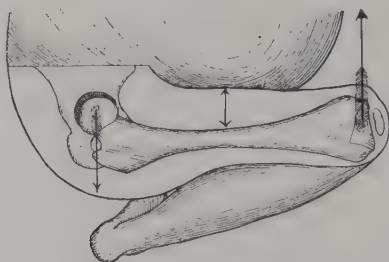


FIG. 9.—Mechanism of luxation of the hip in a case of retention of the urine in a fetus of four months.

(Fig. 9). (d) Luxation through alteration in the means of fixation afforded by the muscles and ligaments. These changes are very analogous to those which Durante has described in club-foot and which he has called plasmoidal regression (Fig. 10).

In a word, these luxations result either from an exaggeration of the obstacles which oppose the necessary flexion of the thigh, or to a weakening of the means of union, or to a skeletal malformation.

These teratologic luxations have only been found up to the present time in the fetus born dead or nonviable. They often accompany other malformations, in particular spina bifida, and they are not rare. Relative to other congenital malformations they are even frequent—ininitely more frequent than

luxations of other joints. The cause is that in all pathogenic studies of all the congenital luxations it is necessary to bear in mind the defective conditions in which this articulation is normally placed. The human hip during the second half of intrauterine life is subjected to harmful influences on account of the hyperflexion into which the hip is forced. When all the constituent elements of the articulation are normal there result only deformities which are capable of correction, but if one or more of the parts is impaired, the hip may be dislocated.

All the causes capable of producing disturbances of development, alcoholism and syphilis in particular, play a very great rôle in these teratologic luxations.

2. *Anthropologic Luxations*.—I employ this term, anthropologic luxations, to indicate that they result simply from an exaggeration of the normal imperfection of the human hip (excess of torsion of the femur, excess of flattening of the



FIG. 10.—Muscular lesions (plasmoidal regression) causes of luxation of the hip.

acetabulum). The higher the anthropologic elevation the more frequent is the appearance of congenital luxation of the hip.

These luxations have all the same mechanism. They are extremely frequent, and the possibility of a cure in all cases by appropriate treatment gives to the pathogeny and therapy of this difficulty a progressively increasing importance. They do not exist at birth, and in this they are completely different from the teratologic luxations which are met with sometimes and which would be met with often if they were systematically looked for.

They must not be confused with the sublutable hip of the new-born. This condition is frequent in our country. It

arises when the hip being placed in flexion-adduction, a slight force applied to the knee, combined with force from within outward on the thigh, cause the head to half emerge above the posterior border of the acetabulum. The displacement of the thigh toward the flexion-abduction makes the head re-enter the cavity. A sudden spring indicates the coming out of the head. Another announces its re-entrance. This difficulty is almost spontaneously corrected in a length of time varying from several days to several months. More frequent among girls than among boys, it suggests that the predisposition of the

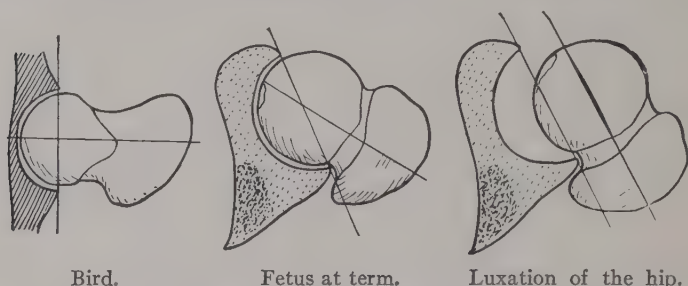


FIG. 11.—Horizontal section of hip, the three subjects being considered in their normal erect position. The hip of the bird is perfect. The epiphyseal axis of the femur is perpendicular to the opening of the acetabulum. With the human fetus at term the epiphyseal axis of the femur is very much inclined, the posterior border of the neck touches the acetabulum. In the luxation the articular surfaces do not fit into each other, the neck of the femur strikes the edge of the acetabulum and the head cannot penetrate the cavity.

female sex to luxation exists even before birth. It is due to an exaggerated diminution in the depth of the acetabulum. If the torsion of the femur is not too great, recovery takes place. If the femur is too much twisted this subluxable condition will be the first stage of a congenital luxation.

The defective conditions under which all new-born human hips exist explain to us why the luxation of this articulation, ten times more frequent than club-foot, thirteen times more frequent than harelip, attacks more than one man in a thousand and more than one woman in two hundred in the northwest of France.

This difficulty is five to ten times less frequent among the yellow races, ninety to one hundred times more rare among the

negroes of Africa and Madagascar than in our white race. As it is entirely lacking in animals it merits the name "anthropologic luxation." It is much more frequent in the female sex, which is anthropologically higher than the male.

Some authors have deduced from the foregoing that the luxation was a malady of civilization. This is not our idea, inasmuch as the difficulty is three times less frequent in our great cities than in our country districts.

Pathogenic Mechanism.—The malformations of the femur and the acetabulum, however great they may be, only produce luxations after birth when the child unbends itself for dorsal decubitus and then for the erect posture. It is, in fact, one of the characteristics of the human species to pass from an excess of flexion in the uterus to an excess of the opposite condition after birth. The deflexion of the body completed by the lumbar incurvation is accomplished in great part in the hip. Only the phenomena which take place in this articulation interest us here.

In the normal infant in the extension of the thigh the anterior fibers of the capsule directed vertically are stretched. Supported by these, the femur untwists, while the cavity becomes hollow again. But if there is an excess of torsion in the femur, if the acetabulum is too much inclined forward, if the cavity is too vertical, and above all if these three defects are united in the same patient, luxation will be inevitable. The anatomic malformations necessary and sufficient to produce luxation after birth are: (1) An exaggerated torsion of the femur. (2) The too great inclination forward of the acetabulum. (3) A too vertical position of the acetabulum.

To explain all the details of this luxation is very complicated, but if one is content with the absolutely indispensable factors nothing is more simple. In order to render the mechanism which exists at the production of this deformity still more simple to understand we have had a jointed apparatus made representing the pelvis at the time of birth with the two femora. On one side it is easy to voluntarily reproduce the torsion and detorsion of the femur as they exist in the normal case; on the other

side we can cause the luxation and make the mechanism comprehended even by persons not all conversant with anatomic and medical science. As this apparatus cannot be utilized here we will have to be content with a written explanation.

In birds and the quadruped mammals (Fig. 11) the axis of the superior extremity of the femur is perpendicular to the plane

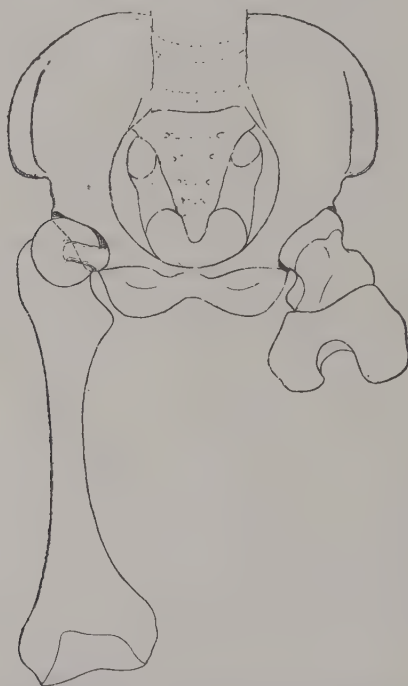


FIG. 12.—Mechanism of anthropologic congenital luxation of the hip. Prepared during intrauterine life by the torsion of the femur, it is produced in the deflexion of the thigh necessary for dorsal decubitus and the erect position. On the left, where the femur is in flexion, the head rests well hidden in the cavity. By the single action of extension one sees, on the right, the head emerge from the cavity because the femur is too much twisted and the cavity too oblique forward.

of the opening of the acetabulum. In the human fetus of four to five months the orientation is still satisfactory without being perfect, on account of the obliquity forward of the acetabulum. In the fetus at term, on account of this obliquity forward of the acetabulum, and on account of the femoral detorsion, the superior epiphyseal axis of the femur is very much inclined on the

plane of the opening of the articular cavity. Let us suppose that the inclination forward of the cavity and the torsion of the femur are exaggerated so as to render the superior epiphyseal axis of the femur parallel to the plane of opening of the cotyloid cavity. This is the habitual state of affairs in the congenital luxation of the hip.

In the position of flexion of the thigh (Fig. 12, left side) the very twisted femur directs its head upward, inward and backward. The acetabulum looks downward, outward, and forward. The reciprocal orientation is perfect, and the head of the femur rests well within the acetabulum. The luxation has no reason to take place in this position, which is approxi-

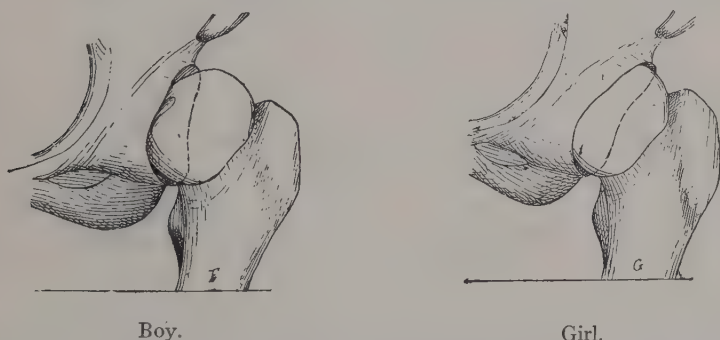


FIG. 13.—The acetabulum of a boy. Very oblique below; the femoral head well fixed. The acetabulum of the girl, which is less oblique below, does not hold the femoral head as well.

mately that of the fetus in the uterus. The luxation does not take place during intrauterine life, but after birth the femur is carried in complete extension, which is necessary for dorsal decubitus and the erect standing position. The neck then becomes oblique, forward and inward. As in Fig. 11 it becomes parallel to the opening of the acetabulum. In the movement of deflexion, and before it can be completed, the posterointernal face of the neck strikes the posterior part of the acetabular border obliquely, above and outward. The entire upper extremity, pushed by the inclined edge of which it moves, is displaced from within outward in proportion as the extension is completed. The head is thus turned away from the base of the acetabulum (Figs. 11 and 12).

In the course of this displacement the articular pressure is diminished. The relative vacancy distends the round ligament, narrows the capsule, and diminishes the depth of the cavity, the base of which is raised. At the same time the rim gives way and the insufficient cavity can no longer retain the head. All these changes are made slowly in several weeks or in several months.

By the tonic action of the longitudinal muscles of the thigh and the supplementary action of the weight of the body in the standing position, the femur, turning around, rises little by little, the head comes out from the atrophied acetabulum, and moreover encumbered by the round ligament. Newly born boys

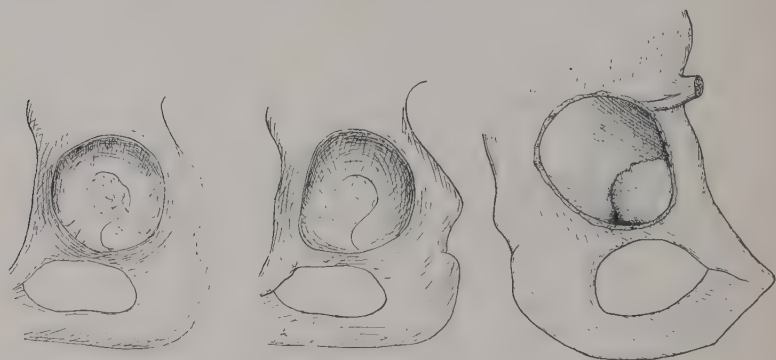


FIG. 14.—From left to right: Normal acetabulum, very slight malformation, and more marked malformation. These are the premonitory lesions of this acetabulum.

have a pelvis broad above but narrow below on account of the coming together of the ischia. The result is that here the acetabulum is directed strongly downward (Fig. 13). This orientation is favorable for giving the femur a solid support. With girls, the formation is the reverse. Here the subpubic angle is already very much widened, the ischia are more separated, and the acetabulum more vertical. With girls, therefore, the orientation of this cavity is less favorable. After birth this difference in pelvic conformation completes the predisposition of the female sex to congenital luxation of the hip.

Since the luxations are produced after birth and since they

occur slowly one ought to be able, by making a number of autopsies, to sufficiently observe in the course of their execution the lesions which render these luxations possible. We have been able to do so and have given to these changes the name of premonitory lesions, or preparations for the congenital luxation of the hip. Essentially they consist of the malformation of the head of the femur which facilitates the displacement, and in a giving way of the top of the acetabulum, which by the weight of the head tends to become changed into a groove where its displacement will be from the bottom upward (Fig. 14).

In many children these premonitory lesions are arrested at their very first stages and are cured without leaving any trace. With some, however, they become aggravated and end in a luxation.

Principles of Therapy.—The study which we have just made of the pathogeny of congenital luxation of the hip is thus simplified to the point of becoming almost solely geometrical and mechanical. All the other influences, anatomic, histologic, morphologic, and functional, are subordinate to these, and we do not need to describe them. They have been very well studied by our predecessors.

As far as concerns the treatment we are going to indicate in the most practical way possible the principles that ought to guide us in obtaining the greatest proportion of success. Here one finds very happily that the maximum ought to be in the neighborhood of the total number of cases. With very small children of less than three years of age congenital luxation of the hip ought always to be cured (1) provided that the articular surfaces are put in exact coaptation in such a manner that the new acetabulum exactly corresponds, center for center, to the old one. The pressure of the head will hollow out this cavity, and the movements of the head will be a still more powerful agent in the scooping-out process. If we wish to re-form an articulation it is not to immobilization that we ought to have recourse, but to motion. Function makes the organ. (2) Provided that the femur is untwisted so that the neck and the head are well oriented in relation to the acetabulum. The

anatomical reason for the congenital luxation indicated in Figs. 11 and 12 will thus have disappeared. (3) Provided that the articulation has recovered its power of action and the leg is in good position. This is one of the greatest causes of difficulty in older patients and increases the period of functional restoration considerably. The restoration may even be incomplete for an indefinite time on account of the osseous or muscular destruction brought about by age.

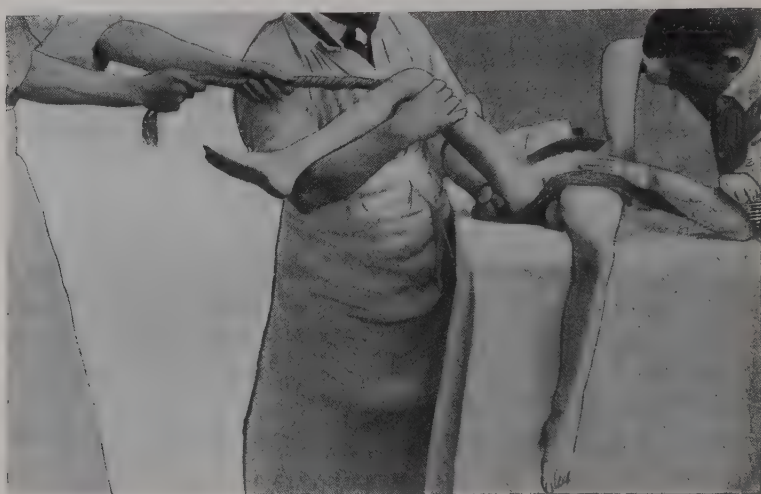


FIG. 15.—Reduction of the luxation in large children. Fixation of the pelvis with a skein of wool and an assistant. Traction on the thigh with the aid of another skein. Flexion-abduction-rotation inward and propulsion of the greater trochanter.

Reduction of the Luxation.—All the procedures are good provided they bring the head back into the acetabulum. That which we employ is only a simplification of the procedure of Paci-Lorenz. No preliminary continuous extension; no traction in extension before the reduction; no tenotomy or rupture of the adductors, but quite simply to proceed in the following manner:

Flex the thigh to ninety degrees or a little more. Make traction parallel to the axis of the thigh at the same time that the trochanter is propelled from behind forward. A rotation inward, drawing the sole of the foot toward the floor, facili-

tates the reduction. With large children the reduction is often an actual exertion of forces (Fig. 15). With small children it is often possible to accomplish the reduction with the fingers without any force. Here it is a good means of confirming a doubtful diagnosis.

A click, often very distinct, indicates the re-entrance of the head into its normal place, and in general the more definite this is the better the initial stability. That this stability may be good, medium, or mediocre is of no importance, but in certain

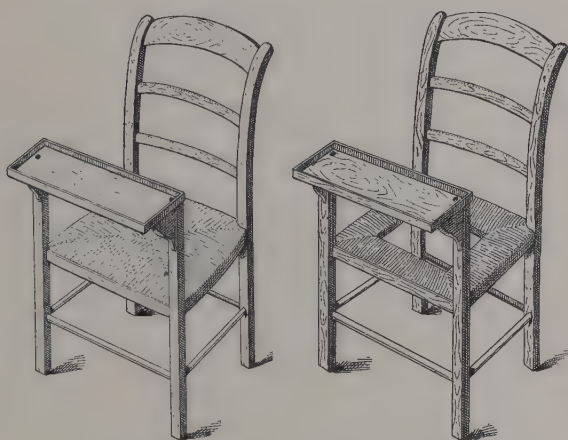


FIG. 16.—Children with bilateral luxation are placed on these chairs.

cases, however, it is extremely bad, and then it must be recognized. The danger of not maintaining the head in the cavity constitutes the great difficulty of treatment.

Immobilization.—This first phase is necessary, but it must be shortened in older children in order to prevent stiffness. Three months is the maximum, two months the minimum, necessary even for older children.

It is always prudent after putting on the first immobilization apparatus to verify by the radiograph the exactness of the reduction. An error is possible even in the hands of the most experienced surgeon. It is desirable that this examination should show the diaphysis of the femur to be parallel to the

line passing through the two cartilages in a Y. This general rule admits of exceptions.

During the entire duration of treatment the part will be maintained in the first position of Lorenz: flexion to ninety degrees, abduction to ninety, no rotation. In unilateral luxation the knee is only flexed at forty-five degrees in order that walking may be possible (Fig. 17). In bilateral luxation the knees are flexed to a right angle in order that the children may be less encumbered. These children spend the day in a special chair



FIG. 17.—First plaster cast for unilateral luxation.

(Fig. 18) into which they are wedged in front and behind. The functional results are better in proportion as the children are treated at an early age. Many of them during the first years of life are incorrigibly unclean. Some who had already been educated from this point of view lost in this respect after they had been placed in a plaster cast. We have, nevertheless, managed to render the plaster casts tolerable and to preserve them from dangerous humidity by placing under the children either a flat basin (Fig. 19) or a lattice hammock (Fig. 20).

Experience has led us to continue the use of this apparatus ordinarily for three months. The purpose of this first period

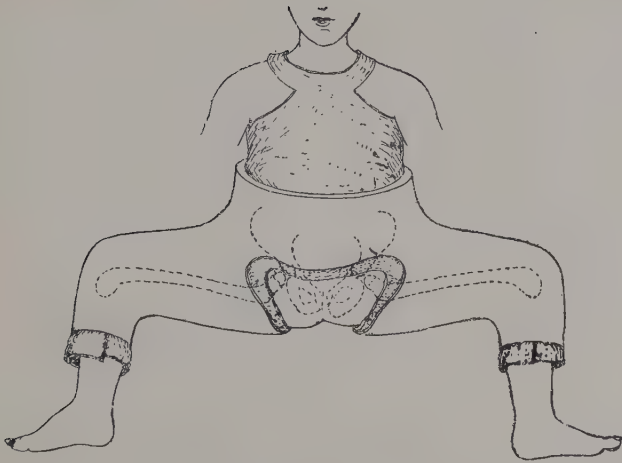


FIG. 18.—First plaster cast for bilateral luxation.

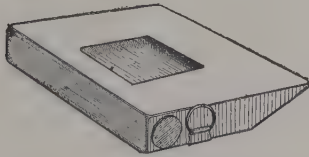


FIG. 19.—Flat basin on which the child can be laid during the night and seated during the day.

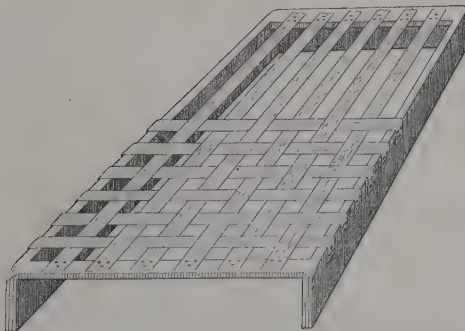


FIG. 20.—Lattice hammock. A pillow is placed under the head. A flat basin for urine and fecal matter is used. This preservation against the action of the urine is often imperfect. Nevertheless, the annoyances which result are insignificant in relation to the advantages of early treatment.

is to fix the femoral head in the acetabulum and to procure for it the support necessary for the second period.

Detorsion of the Femur.—We obtain this by the use of a special apparatus, articulated, and no more complicated than many others, but which necessitates a careful apprenticeship. Its action, which is purely mechanical, is not at all difficult to understand, and its use is sufficiently simple to make it available for any orthopedic surgeon. All orthopedic surgeons of to-day are necessarily mechanics.

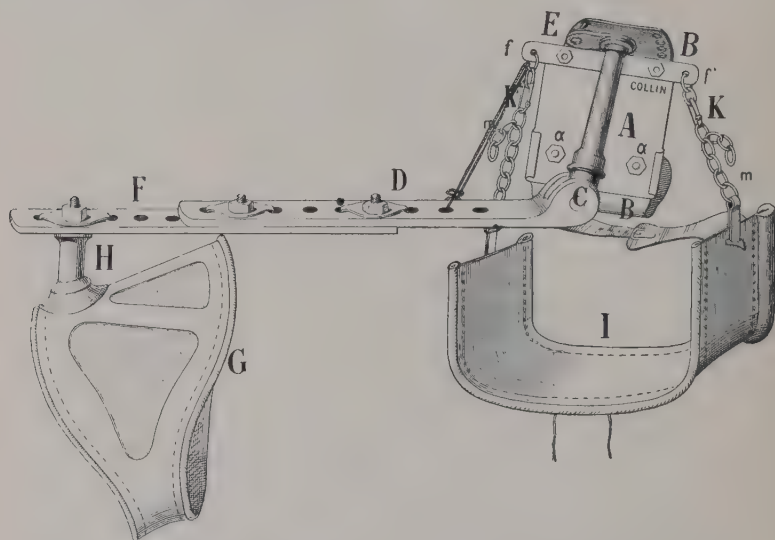


FIG. 21.—Unilateral apparatus, as it is furnished by the manufacturer.

The apparatus is composed of a plate sealed in a plaster corset. This plate carries on one side a rod terminating in a bracelet which maintains the abduction of the thigh; on the other side is a hollowed-out piece which passes under the thigh and maintains the flexion. On the support of this underthigh piece the femur will rock and attain a deformity the reverse of that which it has undergone in the maternal uterus. It will untwist. Four sizes of this apparatus exist for different ages and there are two distinct models, one for bilateral and the other for unilateral luxations.

When in place the apparatus is composed of a plaster corset

made extemporaneously. While the corset is wet a plate is sealed in it which carries the other parts of the apparatus. Special precautions are taken to prevent the pressure of this corset causing sloughing over the osseous prominences. As a preliminary measure the child has been covered with eight thicknesses of cotton tricot, and on the spines of the ilium and

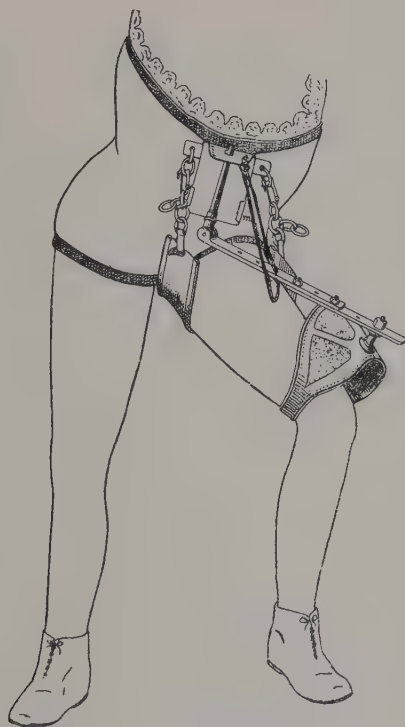


FIG. 22.—Apparatus for unilateral luxation.

the vertebral column pads are applied containing sawdust of tanned wood. The bracelet which encircles the lower extremity of the thigh is fixed to the end of the jointed rod, and maintains the abduction. This should remain in the neighborhood of ninety degrees. This position, combined with an equal amount of flexion, is the best to untwist the femur. The under-thigh piece will then be carried by the chains, the length of

which will be regulated in such a way that the flexion remains in the neighborhood of a right angle.

In attempts at walking, and in all the efforts to extend the thigh, the femur will form a lever of the first class, of which the power will be at the knee, the fulcrum on the underthigh piece, and the resistance at the superior extremity of the femur.

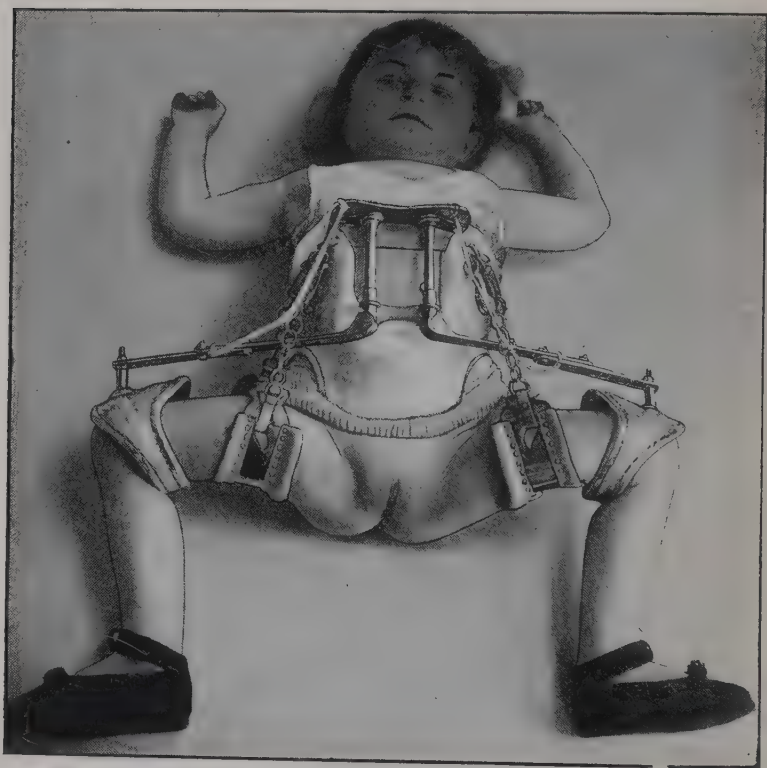


FIG. 23.—Apparatus for bilateral luxation.

There through the effect of the apparatus the epiphyseal mass will turn on the diaphysis, little by little, in a direction opposite to the first torsion. The femur will untwist. The action of walking and the different movements that one can make the child perform is completed by a continuous extension applied during the night. In children of the age of twenty-eight

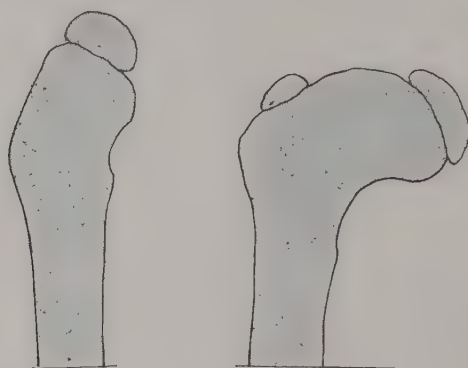
months at the most this apparatus is maintained for five months if the luxation is unilateral and for six months if it is bilateral. With older children the apparatus is only maintained for four months if the luxation is unilateral and for five months if it is bilateral. At the end of the treatment the apparatus is taken off without any special precaution and the child is abruptly given complete liberty.



FIG. 24.—Apparatus simplified by leaving off the underthigh piece. Suitable for inexperienced operators, for very bad initial stability, and for unclean children.

Particular reasons, such as a certain degree of inexperience on the part of the operator, extreme instability of the reduction, special uncleanness on the part of the child, often make it necessary to dispense with the underthigh piece and adopt the arrangement indicated in Fig. 24. A chain stretched from

the plate to the rod which carries the bracelet prevents deflexion. The apparatus is thus much simplified and its employment is easier. By wearing this a month at the most the correction is gradually brought about. The deflexion is accomplished. This is due then to the muscular contractions which in the flexion-abduction have in general a tendency to untwist the femur. The continuous extension at night is of no use, then the apparatus is arranged in this way. In whatever form it exists this apparatus has for its object the promotion of the detorsion of the femur, together with a certain mobili-



Femur much twisted.

Femur well untwisted.

FIG. 25.—Radiograph of a very much twisted femur, seen before treatment, and of a femur untwisted after treatment. These two radiographs are taken through the anterior aspect.

zation of the hip. The mobilization is obtained by spontaneous movements and by forced movement. The detorsion may be produced in a slight degree by the continuous night extension, but the most powerful detorsion is determined by the voluntary contraction of the muscles. It is, therefore, indispensable that the muscles of the buttock and the thigh should be subjected to vigorous and repeated contractions. For this object the best exercise is walking: the treatment is essentially ambulatory. When this is impossible, as in the case of small children with bilateral luxation, they are placed on the stomach and allowed to amuse themselves in that position and to move about with the aid of hands and feet. Only immobility in a

chair constitutes a loss of time and exposes the patient to a setback. The chairs represented in Fig. 16 should be forbidden during this second stage. They immobilize the child too much.

Radiographic Study of the Detorsion.—The radiograph alone permits us, I will not say to measure, but to determine the detorsion. If we wish to make a complete study on the living subject the task will be very complicated, but in practice it can be much simplified. It is sufficient to compare two radiographic tests, one made before the reduction of the luxation and the other six months after the completion of treatment. For the two plates the child is placed in two exactly similar positions, symmetrical dorsal decubitus, with the legs hanging straight down. Before the treatment the shadow of the femur appears very little bent because the head is in anteversion. Its form recalls that of an I. After treatment the anteversion is corrected, the neck is almost parallel to the radiographic plate, the shadow of the femur recalls the form T (L turned about). It is very strongly bent.

In actual practice torsion and detorsion are sometimes more, sometimes less clear. This simplified proceeding has the advantage of not obliging one to take any supplementary radiographs.

Functional Restoration.—In all the methods of treatment it is the longest and most tiresome with children who are a little grown. We are only considering here the cases where an anatomical cure has been obtained. With little children this functional restoration is accomplished quickly and well. The abduction with apparent lengthening persists for a very long time, for several years. The articular stiffness diminishes with extreme slowness in spite of the voluntary motions and active and passive gymnastic exercises which are carried out. It is sometimes even necessary to promote the drawing together of the knees, sometimes by continuous extension and sometimes in other ways, but it is always necessary to proceed with gentleness and patience and to be content with diminishing the distance a few centimeters each month.

In the course of this long period of progressive improvement

it is rather frequent to see attacks of pain with contracture and articular stiffness simulating arthritis. With time and the adjuvant influence of complete or relative rest these attacks disappear in a few days, weeks, or months.

We can divide the convalescence, the period of restoration to function, into three categories. (1) Convalescence which is short and regular, almost constant, in young children, where the flexion and abduction gradually diminish and disappear in a length of time which varies ordinarily between three and fifteen months, where the motions of the articulation recover in approximately the same time. A perfect gait is obtained ordinarily in a time varying from six months to two years. (2) Convalescence which is prolonged and irregular, where the phenomena of stiffness and apparent lengthening are still more slowly corrected. This stiffness is somewhat exaggerated by the appearance of attacks of pain with contracture in the affected articulation. Two, three, sometimes even five years, may be necessary for a perfect restoration of function. This slowness of recovery comes from a single cause, the age of the child. (3) Convalescence which ends in an incomplete restoration of function. Peculiar to large children, it proceeds as in the foregoing cases, but in spite of all supplementary treatment the restoration to function does not become complete. There finally remains a claudication through muscular insufficiency and articular stiffness. These incomplete functional results always have for their cause malformations and lesions due to age. It will be necessary then in certain older patients to be content with simple functional improvement.

Accidents and Complications.—The treatment that we employ, like all others, does not shield one from accidents. With careful supervision, however, the greater part of them can be avoided. The most frequent are (1) the sloughs that one can detect by constant supervision. (2) The re-luxations in the apparatus, which one can prevent by proper adjusting and regulating the apparatus. (3) Fractures either during the reduction or in the second apparatus. These are almost always avoided by recommending incessant watchfulness on the part of the parents.

The late re-luxations are seen in one case in ninety, and always during the first six months of convalescence. If the children are very young a second course of treatment, somewhat prolonged, ordinarily brings about recovery.

The anatomic results secured by the treatment have to their credit about 97 per cent. of cures. The exact and definite repositions are just as frequent in the bilateral luxations as in the unilateral and in large children with reducible luxations as in the little ones. The relation between the anatomic results and the functional results may be summed up thus: (1) Without perfect anatomic correction there is not absolute functional cure. (2) Anatomic correction procures for all the very little children integral functional recovery. (3) In spite of perfect anatomic recovery judged by the radiograph the functional restoration may remain incomplete in large children. The articular stiffness and muscular insufficiency are the habitual causes of these incomplete results. All other things being equal, they are proportionately more frequent as the children are older. Their prophylaxis rests in early treatment.

In this rapid review of the mechanism and treatment of congenital luxation of the hip I have made no pretence of giving anything but a very general sketch for the purpose of showing the very great and varied interest which is presented by the causes of this difficulty. I consider it as a price paid for the anthropological elevation of the human species. I should consider myself well rewarded if the therapeutic ideas which I have briefly set forth should give some reader the desire to employ the very simple method that I recommend, and which is so constantly perfect in its anatomic and functional results provided the children treated are very young.

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